POWER

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After a While

DO YOU ever stop to think what things will look and be like after a while?

When you think you want something pretty badly and are tempted to strain your resources to get it, do you stop to think what it will look like to you after a while, when its newness and glamour and novelty are worn off?

In choosing your investments of time, money, interest and occupation, do you consider the lasting qualities of the returns and what they will mean to you after a while?

Here is a nice new instrument or apparatus placed in your charge. What will it look like, what will its use have amounted to after a while?

In the hands of one man it will be a tarnished monument of neglect, the object of no more care and attention than will keep it in desultory service or perhaps covert desuetude.

In the hands of another it will be kept in the pink of condition so far as appearance is concerned and be paraded ostentatiously upon occasion, but with no real understanding of its principles, purpose or possibilities.

Another will know or learn what it is intended to do and how it is intended to do it. He will study its application to his conditions and opportunities and realize with it the results that its inventor promised and its purchaser expected. And in his hands it will, after a while, have been a paying and satisfactory investment.

If managers could be assured of this kind of outcome, there would be less difficulty in getting useful but dispensable apparatus into power plants.

F. R. Low

A Little Engineering Study

Saves $24,000 Yearly in Hospital

THIS is an account of the great savings obtained in a small power plant through the application of well recognized engineering practices. Readers may find here a suggestion as to how savings can be made in their own plants.

THE startling reduction in the power plant operating costs of the Long Island College Hospital may be taken as indicative of the opportunities for similar savings in many other power plants.

This plant supplies steam heat, electric lighting and power, hot water to the laundry and other services required about a hospital. In the light of present-day developments the machinery installed at the time the hospital was built cannot be claimed to possess any high degree of efficiency, but poor operating procedure and more or less neglect prevented the plant from showing even the mediocre efficiency that was possible.

The situation at this Brooklyn, N. Y., hospital finds counterparts in thousands of plants. Designers may endeavor to lay out a plant which, with all things considered, is the most economical, and compare the expected thermal efficiency with that of the ideal operating over the predetermined temperature range, but owing to unfavorable operating conditions, the expected results fall short of attainment.

The hospital power plant was installed a number of years ago and consisted of two 72-in. by 18-ft. horizontal tubular boilers, hand-fired, two 35-kw. 250-volt 3-wire generators driven by high-speed, slide-valve automatic engines and a 75-kw. generator direct-connected to an engine of similar type, as shown in Fig. 1. Later, increased steam demands prompted the addition of a 1,500-sq.ft. cross-drum water-tube boiler, also hand-fired. By reason of the residential character of the neighborhood it was found necessary to use anthracite for fuel.

Exhaust steam from the engines is used on the heating system; at about 2 lb. back pressure an atmosphere relief controls the back pressure and affords an outlet for the steam during the summer months. The radiator returns were brought back to a steel tank, out of which the boiler-feed pump drew its supply.

Live steam was used in the laundry mangles, and for the hot wash water a heater was installed in the power plant, with live steam fed to its heating coils, the drips going back into the receiver tank.

As no refrigerating machine was installed, the entire refrigerator requirements were met by the purchase of ice.

It will be observed that the plant as designed could not be expected to be operated efficiently even under the direction of the best of engineering talent.

The management was concerned primarily with the supervision of the hospital as a hospital, and the details of the several departments were attended to by the respective heads. The engineer operated the power plant with the machinery at hand, and as is the case in many plants, his suggestions as to repairs, alterations, etc., if requiring a financial expenditure, received scanty reception by the authorities higher up.

The firing aisle, between the boiler fronts and the basement wall, as will be seen from Fig. 3, was very limited in width. In cleaning fires the fireman was compelled to stand almost in the hot cinders, so that the cleaning was postponed as long as possible and then performed hastily and ineffectively. The amount of combustible removed along with the cinders was, of course, extraordinarily large.

The steam lines were left uncovered, and the amount of heat loss by radiation was enormous. Little of this heat actually warmed the building, since the air currents carried much outside.

Owing to a change in management a study was made

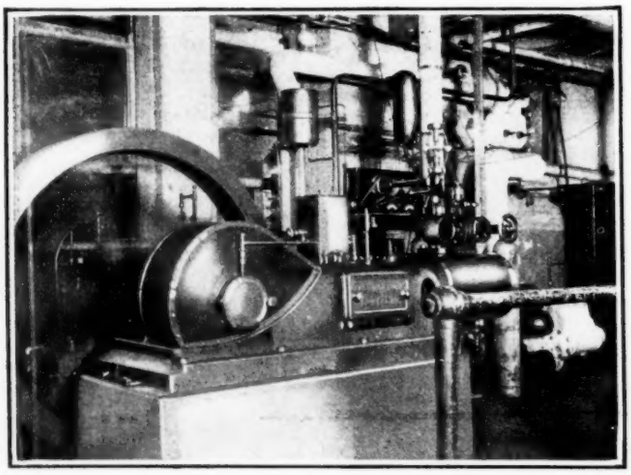


Fig. 1—CO_2 ice machine driven by slide-valve engine

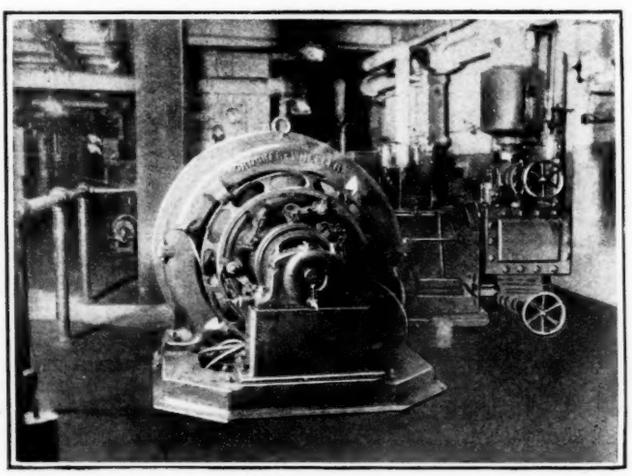


Fig. 2—One of the direct-current generating units

of the entire hospital organization with a view of reducing the operating expenses. Among other departments the power plant received some attention.

Even to one who understands little of the details of engineering, the disadvantage of exposed piping is evident. Consequently, the first step in improvement was the covering of all steam piping.

Since hand-firing without a smoky chimney necessitated the burning of anthracite and the use of all three boilers, hand stokers were installed. Not only did this permit a change to bituminous coal procurable at a lower price, but an increased efficiency was obtained. In addition, only two of the boilers were needed, the third being held in reserve.

It was found that several years ago the condensate tank had failed and the heating returns had then been dumped into the sewer. As the heating to 212 deg. F. of the feed water taken direct from the service lines represented about 15 per cent of the boiler duty, the advantage of installing a feed-water heater was apparent.

This heater, shown in Fig. 4, is jacketed with insulating material and was placed in the engine room so that the heating returns fed to it. The exhaust line was opened and a new connection run to the heater. The saving made by the several alterations is $24,000 per year.

Unfortunately, to permit the boiler feed pump to operate under a slight gravity head, the heater was elevated above the floor level. This has not proved to be the best location, for it is impossible for the condensate in the returns from the first floor and the basement radiators to enter the heater. These drips are now being discharged into the sewer. The new engineer is preparing to install a receiver tank which he has constructed out of a discarded separator. Thus the drips now escaping to the sewer will be drained into this receiver and then elevated to the heater by a reclaimed duplex steam pump. The live steam to the laundry water heater was eliminated through a connection made to the exhaust main. Since the laundry uses large quantities of hot water, the saving obtained by the employment of exhaust steam was considerable; each 10,000 gal. of water heated formerly required over one-half a ton of coal.

In making the change, the higher level of the new feed-water heater compared to the position of the laundry heater was overlooked. This caused the heater coils, which were to discharge to the feed heater, to become waterlogged. As a temporary expedient the drain is now to the sewer, but as soon as the sump tank already mentioned is in place the condensate will be saved.

Another opportunity for a saving is in the control of the live steam to the laundry mangles. At present the steam is allowed to blow through. The same wasteful plan is followed with respect to the steam to the 50 sterilizers in the hospital.

To eliminate the purchase of ice, a 15-ton carbon-dioxide refrigerating plant was installed. The compressor is direct-connected to an Ames slide-valve steam engine. Refrigeration is by brine, two motor-driven centrifugal pumps having been installed for circulation. The capacity of each pump is too great, and lately a used duplex steam-driven pump has replaced one of the motor-driven units.

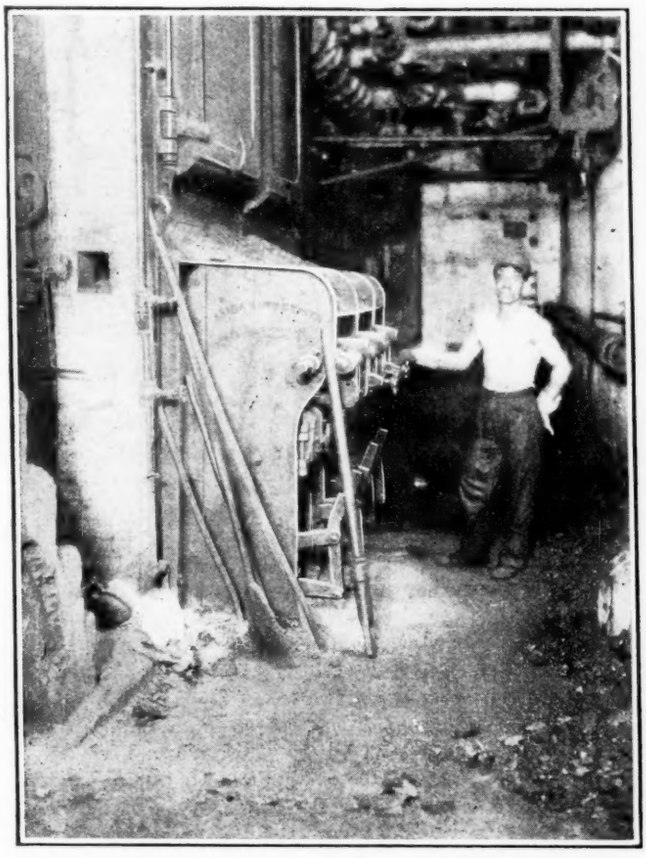


Fig. 3—Water tube boiler after installation of stokers

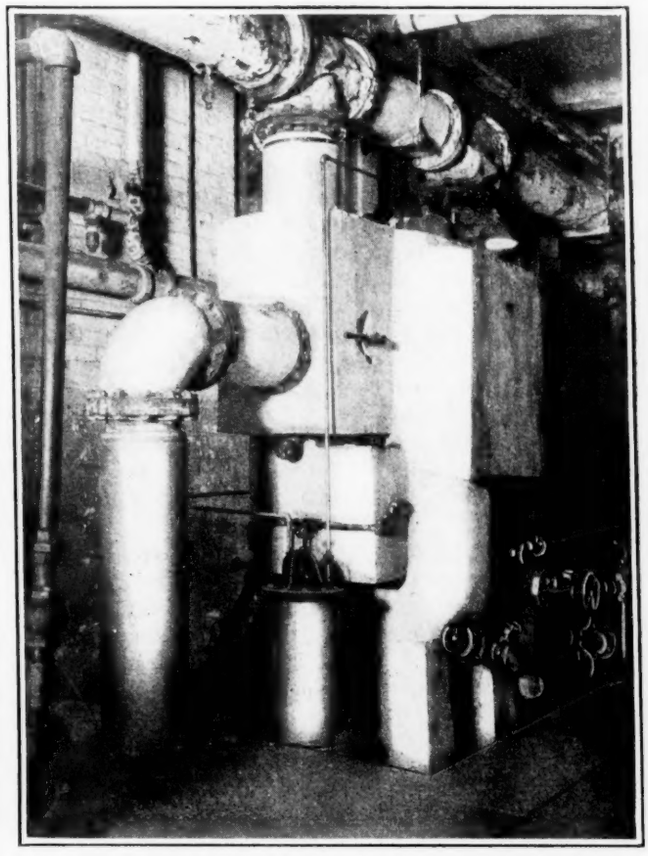


Fig. 4—Feed-water heater recovers radiator returns

Select an Extraction Turbine To Fit the Job

By WALTER SLADER

A BAD selection may fall down and bring discredit on a good method. The extraction turbine can effect great savings, but it must be designed carefully to fit the variations in power and heating demands. The author shows how to go about an intelligent study.

STEAM is one of the most convenient carriers of energy and an aid in changing heat energy into work. But when this steam is used in the most effective way yet devised to produce power—that is, in a condensing turbine generator—a large portion of its energy serves no useful purpose, but must be rejected in the circulating water from the condenser. Where electrical energy is the sole product, this unfortunate condition prevails and is unavoidable. However, such industries as require, in addition to power, large quantities of steam for manufacturing processes or heating, can frequently make use of a considerable portion of this energy with resulting total savings.

To make clear the comparative size of the quantities being considered, if one pound of dry steam at 215 lb. per sq.in. abs. could be discharged through a perfect turbine to a condenser at 29 in. vacuum, it could theoretically transform to useful work 372 B.t.u. Used in an actual turbine, it would deliver to the generator coupling somewhere between 230 and 300 B.t.u., depending on the size and type of the machine. The heat that would have to be supplied to the pound of steam to make this possible is 1,152 B.t.u. The portion of this that is not transformed into work serves no useful purpose; that is, 850 or 900 B.t.u. must be wasted in the circulating water.

Extraction Turbines Are More Economical

An extraction-type turbine affords the most satisfactory means of getting this energy where it can do further effective work in an evaporator, digester, heating coil, dye tub, kier or other apparatus.

Although an extraction-type turbine, considered on the basis of power alone, of necessity uses somewhat more steam per unit of power than a good turbine with no bleeding, the fact that the unit performs a useful heating function usually results in a reduction in the total steam demand for power and heat together.

This type of unit has for a long time been installed to provide power and process steam for a wide variety of conditions and uses. There are many such installations, and many more units are being and should be put to the same or a wider range of work. Most of them have proved satisfactory and profitable, but a few have not. It is the purpose of this article to analyze the difficulties and to suggest ways of planning such installations to make certain of satisfactory operation.

Perhaps the largest group of turbines intended to be used as bleeder machines, but which are no longer operated or no longer make use of the extraction devices, owe this either to changed plant conditions or to some form of obsolescence. Processes have often completely changed, doing away with the need for the steam these machines were furnishing. The rapid growth of the power plant often entails difficulties in space and boiler capacity. Recent growth in the size and efficiency of steam turbines often forces older units to stand-by service.

Difficult to Change to Higher Steam Pressure in Industrial Plants

There has been a steady increase in the boiler steam pressure used in both service and industrial plants. This has been especially rapid of late in the public service field, but within a somewhat narrower range it is also evident in new industrial power-plant equipment. This will carry with it many real advantages for extraction installations.

However, in industrial plants the boiler-house equipment already installed must often continue in service; therefore it is only in rapidly growing ones that a change of steam pressure, however desirable, is feasible. For this reason many extraction units, if used at all, have had to go into service handicapped from the start with too low a throttle pressure. Owing to this low throttle pressure, in order to keep both the required proportion between power output and quantity of extracted steam and to keep the size of turbine and its first cost within bounds, the extraction pressure has to be made as low as is possible without reducing the efficiency of the heating service.

Often, when extraction pressures are limited, proper results in connection with at least some use in the manufacturing plant, will depend upon a careful design of the entire piping system. This can be made, other than by accident, only when a clear understanding of the important facts as to quantities, rates and locations of demand are had previous to construction. With earlier installations the importance of this information was often not fully realized, and sometimes little better than guessed at. It is, therefore, not strange that considerable changes have sometimes been necessary.

Factors in Choosing the Extraction Turbine

The extraction-type turbine is often the proper choice for furnishing both power and process steam because it is really a very flexible unit, capable of working tolerably well throughout a wide range of conditions, delivering much or little power, and much or little extracted steam as conditions may demand. Just because of this capability there has sometimes been too much tendency to consider it as a sort of india rubber unit, capable of stretching indefinitely in all directions, and to conclude that it is not worth while to undertake the arduous task of analyzing its operation.

The sole reason for using this type of unit is to secure the greatest over-all savings. Its efficiency, like that of other machines, decreases in proportion to the width of range over which it must or may work and in proportion to the time it works at points other than those for which it is best adapted. If it works too much of its time far away from points of good performance, it may save much less than would have been possible with a better chosen machine.

It has been thought, too, that its condensing steam rates were not important, which would be measurably true if there were always a demand for a large quantity of extracted steam; but almost always these machines have to run part of the time wholly condensing or with only small quantities of steam being extracted.

These points are emphasized to drive home the importance of a complete study of the conditions under which such turbines will have to operate. Only such a study can serve as a basis for deciding for or against the extraction turbine and for designing the plant for maximum earnings.

Securing the Data

The extent to which information can be found previous to choice of a unit and design of a plant will vary with different installations. It will range all the way from what can be done in the case of an existing plant, which has thorough records extending over a year or more, covering both power quantities and subdivided plant steam uses, and which has under consideration a new power generating unit; to what can be found during a comparatively brief study of conditions, for either an existing plant that has few or almost no records, or a new plant using perhaps entirely new processes.

In general, for practically every case, if all information that can be had in any way is skillfully put together, a reasonably accurate picture of power quantities, with their important daily or seasonal variations and of the several plant steam requirements, with their locations, minimum desirable pressures and momentary, daily or seasonal changes of quantities can be obtained. The several steam uses can be combined to show totals for all processes with their variations.

The question of seasonal demand must also be considered. Of course all water heating and like operations require much more steam in winter than in summer. Allowance can be made for this if plant heating is quite likely to form a part of the winter-time extraction load. This service may require a relatively steady quantity of steam throughout the working day, for any temperature condition, but will vary much with seasonal changes; or, in other plants, it may be an intermittent service, much of the time amounting to almost nothing even in severe weather, but requiring large quantities for short periods. It will often be helpful to plot these quantities on a time base, for a day, a week or a year.

The accompanying chart represents the manner of showing the characteristics of extraction turbines. With the aid of this chart the weight of steam supplied at the throttle can be found for any load and any rate of extraction. With such curves available for the units under consideration, total throttle steam quantities for both the predicted condensing and extraction conditions can be determined, either for the average loads or separately for any period. These can be summed up to find the year's demand.

It might be thought that averaging widely varying power and extraction steam quantities would lead to a large error in final results, but experience indicates that ordinarily, if the times and the total quantities for each are accurately known, little error results provided the work is done with careful regard to such details.

The variation of power quantities if the station is to contain more than one unit, or the greatest demand if it is to contain but one, will determine proper choice of the size of the generating unit. Due provision must be made for future growth.

Inspection of process steam quantities, locations and required pressures will determine whether more than one extraction pressure need be considered. Sometimes

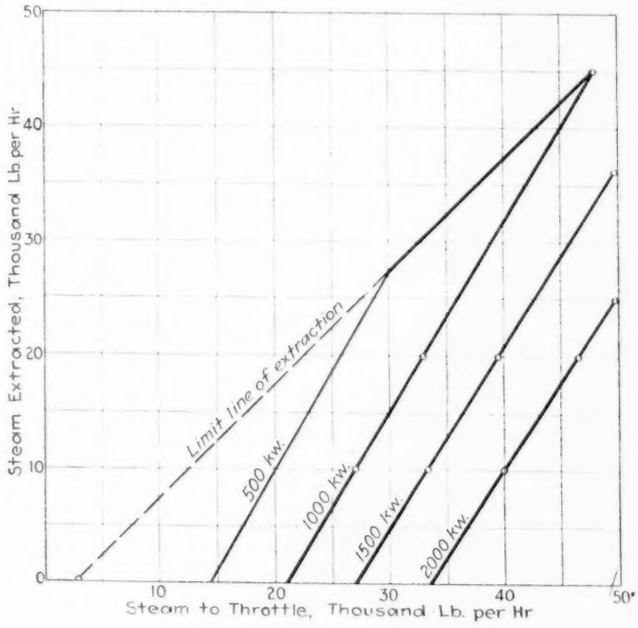


Chart for finding throttle flow of extraction turbine

Drawn for a 2,000-kw. turbine supplied with steam at 150 lb. per sq.in. gage and 50 deg. F. superheat, exhausting at 2 in. of mercury abs., with steam extracted at 12½ lb. per sq.in. gage

two are required. If the boiler steam pressure permits a choice, a comparison of the total fixed and operating costs for a pressure as low as will be satisfactory and for a considerably higher one, with its smaller pipe lines, will be worth while, the one showing least over-all cost being chosen.

The extent of process steam quantity variation and the number of hours of use of each quantity will help to decide whether the turbine should be made large enough to handle all conditions or whether extreme peaks should be made up from boiler steam. Large extraction quantities mean big savings if they extend over a considerable portion of the whole operating time; but if they last only a small part of the time, it may be better to choose a machine with less extraction steam range and a better condensing steam rate curve.

Information regarding locations using process steam pressures and maximum demands will enable estimates to be made of the cost of complete piping systems with their covering for high-pressure distribution and for tentative extraction pressures. This will give further indication as to a most desirable extraction pressure. Later, these data will enable the careful design of all parts of the system chosen. The turbine manufacturers will probably be willing to give, not only condensing steam rates, but expected throttle steam rates and ex-

traction quantities for maximum extraction conditions and for some lower extraction conditions. This should be available at full, three-quarters and one-half loads for these machines, together with information as to quality of extracted steam under the various conditions. Such information enables drawing curves like Fig. 1, the use of which has been explained.

When is the Extraction Turbine Justified?

A comparison of total annual costs should finally determine whether the extraction unit shows sufficient earning to be desirable. Against the extraction unit must be set the fixed charges for the plant and its complete distribution piping system, plus the cost of total throttle steam to the extraction turbine. Against the straight condensing plant will stand the fixed charges for the plant and a complete system for distributing boiler steam throughout the plant, plus the cost of throttle steam to the condensing turbine, plus that for boiler steam to do the same heating as the extracted steam in the former case.

Performance of Typical Extraction Turbines

To illustrate some of the points brought out and to show how the characteristics of these machines can vary to suit different conditions, condensing and extraction steam rates are given in the table for three turbines designed as units A, B and C. The data from unit A were used in plotting the table.

Units A and B are similar. The advantage of the higher throttle pressure in unit B is attested by the fact that this turbine develops more mechanical energy per pound of extraction steam than does unit A, which has about the same extraction pressure. Unit B can

CHARACTERISTICS OF THREE TYPICAL EXTRACTION TURBINES

Kw.	Total Throttle Steam with Extraction, Lb. per Hr.	Steam Extracted, Lb. per Hr.	Steam to Condenser, Lb. per Hr.	Straight Condensing Rate, Lb. per Kw.-Hr.
Unit A—2,000 kw.; throttle conditions, 150 lb. gage, 50 deg. F. superheat; back pressure, 2 in. abs.; automatic extraction at 12½ lb. gage.				
2,000	49,400*	25,000*	24,400*	16.40
....	46,400	20,000	26,400	.....
.....	40,000	10,000	30,000	.....
1,500	49,400*	36,000*	13,400*	17.00
....	39,600	20,000	19,600	.....
....	33,400	10,000	23,400	.....
1,000	48,000*	45,000*	3,000*	18.70
....	33,000	20,000	13,000	.....
....	27,100	10,000	17,100	.....
Unit B—1,500 kw.; throttle conditions, 200 lb. gage, 100 deg. F. superheat; back pressure, 2 in. abs.; automatic extraction at 10 lb. gage.				
1,500	54,500*	53,500*	1,000*	15.25
1,125	41,900*	40,900*	1,000*	15.75
750	30,300*	29,300*	1,000*	17.00
Unit C—600 kw.; throttle conditions, 200 lb. gage, 150 deg. F. superheat; back pressure, 2 in. abs.; automatic extraction at 50 lb. gage.				
600	32,300*	29,000*	3,300*	17.00
450	23,300*	19,500*	3,800*	18.65
300	14,500*	10,300*	4,200*	22.17

*Maximum steam extraction.

also develop much the greater portion of its power from extracted steam because it is designed for extracting up to 98 per cent of the throttle steam at full load, while A allows extracting only 63.5 per cent. A unit with the characteristics of B is better where process steam quantities are large much of the time. On the other hand, when there is likely to be considerable operation under low-load, low-extraction conditions or straight condensing, unit A is more suitable.

Unit C gives a large quantity of extraction steam in proportion to power at high pressure. It would have large earnings under conditions where large power and extraction steam demands prevail over a good portion of the time. It is poor for low-load, low-extraction conditions. A higher throttle pressure would make possible much further improvement. More work could be done by the extraction steam in the turbine. With the higher extraction pressure the higher throttle pressure would be more appropriate, if it could be arranged.

Estimating the Blowdown

By J. D. Jenkins

One of the items in boiler calculations that is guessed at usually and missed frequently, is the quantity of water that leaves the boiler when blown down. Generally, it is estimated by taking a flat figure that varies from 1 to 5 per cent, depending upon the frequency of blowdown. But it may often run over 10 per cent in cases where the water is hard and the concentration and scale accumulate rapidly.

An approximate calculation can be made of this loss where the operation is regular and definite quantities are blown down—that is, one gage or so many inches each time.

Take a Stirling boiler, having 6,000 sq.ft. of heating surface and 42-in. steam drums, for an example. At about the center of the drums, where normal water level occurs, the volume of water contained in one inch depth can be figured by taking the length of the drums to half the depth of the bulges of the ends of the drum. This gives an average length and, for the boiler in question, was 14¾ ft. At this point all edges can be taken as parallel and the sides rectangular.

The volume then would be, per inch of depth, per drum: 14¾ ft. length × 3½ ft. diameter × 1/12 ft. depth = 4.3 cu.ft. At approximately 60 lb. per cu.ft. the weight of water contained in this space in *three* drums is 3 × 60 × 4.3 = 774 pounds.

Our practice was to blow down one gage of water twice in each eight-hour shift, or six times in 24 hours. The depth of one gage was 4½ in., so that the total blowdown per 24 hours was 6 × 4½ × 774 = 21,000 lb. practically.

The boiler, according to an indicating steam-flow meter, was delivering on the average 684,000 lb. daily. The total water delivered to the boiler would include the water blown down, making a total amount used by the boiler, of 684,000 + 21,000 = 705,000 lb. a day. The percentage of blowdown for this boiler would then be 21,000 ÷ 705,000, or 3 per cent.

In calculating the boiler-water losses for periods of one month or more, the water lost in taking a boiler off the line and draining for the purpose of cleaning the boilers, must be added to that of blowdown, as this water has been charged against the boilers on the Venturi meter, but was not evaporated to steam.

Over periods of time the accuracy of this method would depend upon the conscientiousness of the water tenders who do the blowing down. However, proper instructions usually take care of the operators.

If Steam Is Available at a high temperature t_1 and required at a lower temperature t_2, highest efficiency can result only if the temperature of the steam is reduced by passing through a prime mover which develops useful energy. However, in many instances a throttling valve or similar device is provided in place of the prime mover because of simplicity or because the amount of steam involved is too small to use in a commercial prime mover.

Methods of Putting Windings on Squirrel-Cage Rotors*

How End Rings Are Connected to the Rotor Bars by Pressing Them on, by Welding Processes and by Casting Them to the Bars

By B. A. BRIGGS

ONE of the difficult problems in the development of the squirrel-cage induction motor has been to make a permanent connection between the ends of the winding bars and the end rings. Although brazing, welding and casting of the bars to the rings are

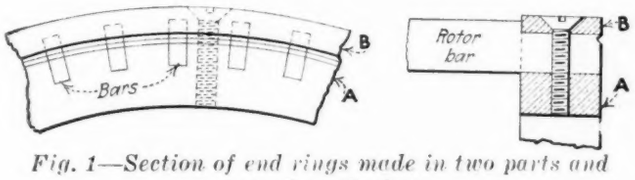


Fig. 1—Section of end rings made in two parts and pressed on the bars

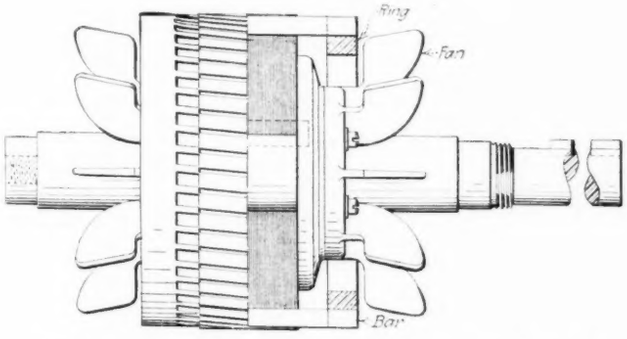


Fig. 2—Rotor with end rings made in one piece and pressed on the ends of the bars

widely used, some successful types of mechanical connections have been developed.

A method of connecting the end rings to the rotor bars by purely mechanical means, without bolts or solder, is used by the Ideal Electric & Manufacturing Co. The bars, which are rectangular in shape, are shouldered down at the ends where they enter the rings, Fig. 1. The end rings are made in two parts, an inner *A* and an outer *B*. The inner section of the ring is slotted on its outer periphery to receive the ends of the bars as shown. After the inner section of the ring has been pressed into place, the outer, or retaining, ring is pressed on over the inner ring. This makes a joint that has contact with the ends of the bars on all four sides. To insure the retaining ring remaining in place under all conditions, a groove is spun in the joint between the two rings and into the ends of the bars. On the large-sized machines a number of equally spaced tapped holes are bored radially through the two rings and machine screws are used to give additional retention between the two rings.

A somewhat similar construction to that shown in Fig. 1, is used by the Marble Card Electric Co., Fig. 2. The end rings, which may be of brass or copper, are radially slotted on their outer periphery to a depth equal to that of the bar. These slots are made to a tight fit for the rectangular bars and then pressed into place in a special fixture and under hydraulic pressure. This gives a press fit to the bar on three sides. After pressing the end rings into position, the tops of the bars are swedged and the ends of the bars riveted, after

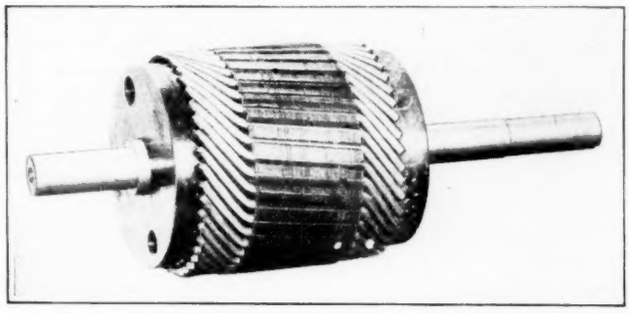


Fig. 3—Rotor ready to have ends of bars welded together to form the end rings

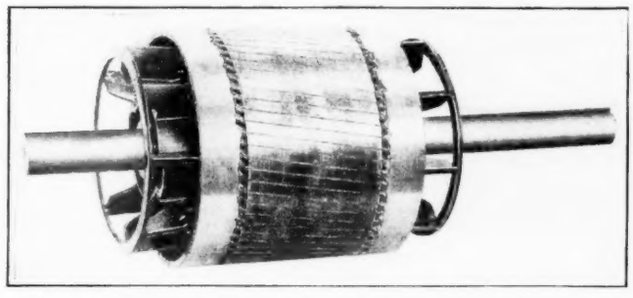


Fig. 4—Same as Fig. 3, but with end rings completed by welding process

which the end rings are dipped in solder to protect the points from corrosion.

Welding the end rings to the bars or casting them on is quite general practice. A method used by the Northwestern Manufacturing Co. is to form the end rings by welding. Round copper bars are driven into semi-closed slots without any insulation. A cooling plug is put under the ends of the bars which are bent so that they will touch, as shown in Fig. 3. This figure

*Previous articles appeared in March 9, May 25, June 15 and Aug. 24 issue.

shows the rotor ready to weld, with the cooling plugs in place.

The welding is done by playing the arc over the ends of the bars, while the rotor is revolved slowly. The outer parts of the bars will be melted by the arc and the metal will flow together, forming a continuous ring. In order to get sufficient cross-section and allow for finishing, additional metal is deposited around the outer surfaces of the rings by playing a carbon-electrode over the rings and at the same time feeding metal, in

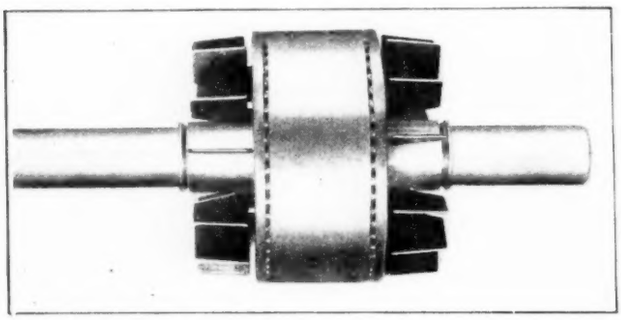


Fig. 5—End rings welded to rotor bars

the form of copper rods, into the arc. The second operation is accomplished while the rotor revolves through one complete revolution.

After the welding has been completed, the cooling plugs are removed and the rings trued up in a lathe and finished off as in Fig. 4. The end rings are ordinarily turned off only on the outer end and around the outer circumference. The insides of the rings usually do not have to be finished, except when it is found that the rings are slightly eccentric.

After turning off the rough outer skin of the welded copper rings, the metal appears to be as solid as the original metal and very seldom blowholes are en-

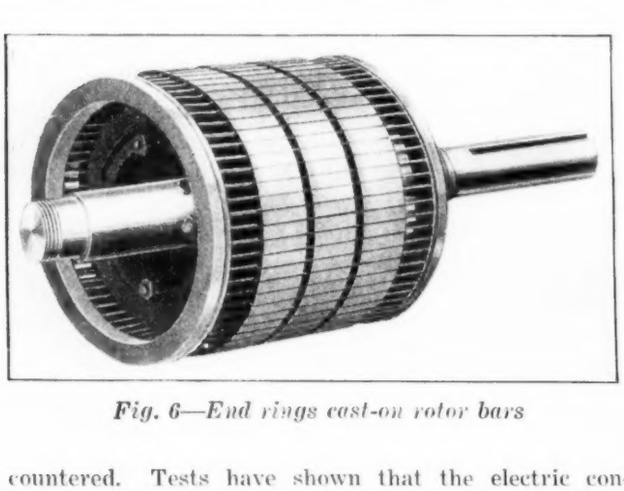


Fig. 6—End rings cast-on rotor bars

countered. Tests have shown that the electric conductivity of the metal is not changed by the welding process. This style ring has been used on rotors for motors rated at 175 hp. at 1,800 r.p.m. No indications of cracks have been found in the rings of such motors, due to the centrifugal force on the rings.

The Lincoln Electric Co. uses round copper bars in the slots, which have a driving fit, without any insulation. On the ends the bars are slightly reduced in size to form a shoulder. The end rings are made from strips of copper bent edgewise into a circle and the two ends welded together. These rings have holes punched in them to correspond to the spacing and size of the ends of the rotor bars and are put on the ends of the bars. The ends of the bars which protrude slightly beyond the outer surface of end rings are then welded to the rings in an automatic machine. The fan blades for circulating the ventilating air are welded to the core end plates

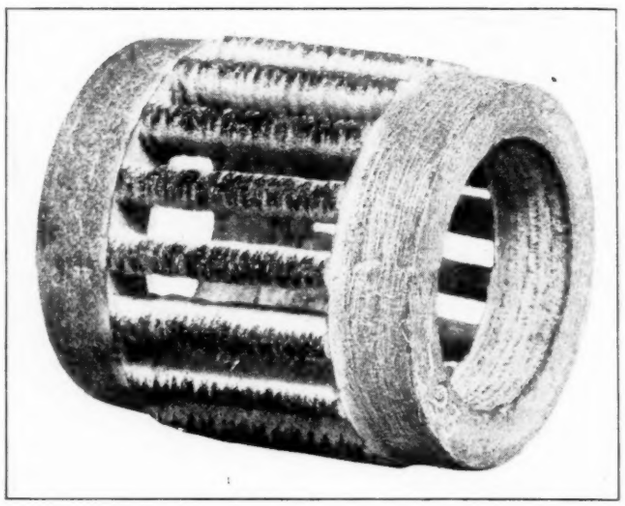


Fig. 7—Complete rotor winding made of cast aluminum

of the rotor. A complete rotor of this construction is shown in Fig. 5.

Instead of welding the end rings on the bars, some manufacturers cast them on. Fig. 6 shows a Fairbanks-Morse rotor with cast-on end rings. The bars are of rolled copper, rectangular in shape, and are driven

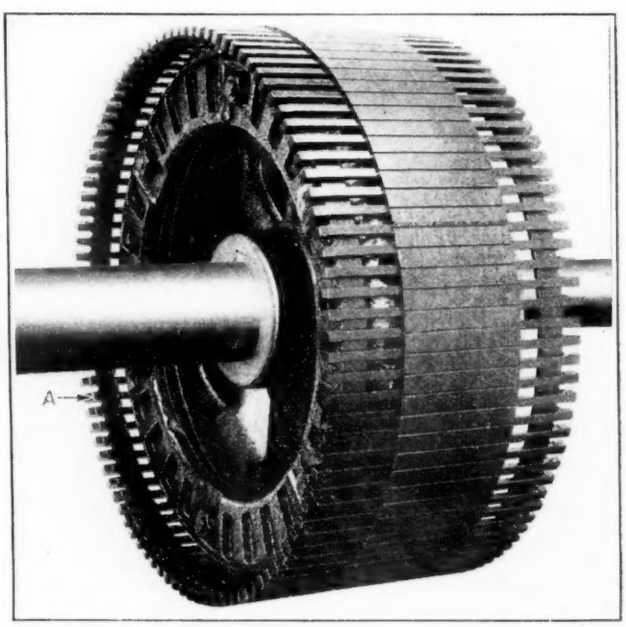


Fig. 8—End rings placed inside of rotor bars and connections made by welding

into the slots without any insulation. After the bars are in place, the rotor is placed on end in a mold and the rings are cast on. The end ring metal is poured at a temperature that causes a fusion of the bars with

the ring. When the rings have been cast, the rotor is put in a lathe and the rings turned to the proper dimensions. An inspection groove is cut in each ring to check the fusion between the bars and ring.

Fig. 7 shows a photograph of a squirrel-cage winding of a General Electric induction motor, which is cast in one piece. After this winding, which is of aluminum, was cast on the rotor core, it was put into acid and the core eaten away, leaving only the winding, and it shows that the casting process has been complete. Since the winding is cast all in one piece, there are no joints of any kind between the bars and end rings. The casting process also anchors the bars in the slots by allowing the metal to run into every space between the edges of the laminations. In the large-sized machines the company uses a welded end ring such as shown in Fig. 8. The bars are driven into the slots without any insulation, and the cylindrical end rings, which have a projection on them for each bar, are placed inside the bars. Then in an automatic welding machine a short bar is placed from the end of the bar to a corresponding projection on the end ring and the two joints are automatically welded. The location of one of the welds can be seen at *A*. In this type of rotor the projecting ends of the bars act as a fan to help circulate the ventilating air through the machine.

Numerous attempts have been made to construct rotor windings without any joints by using one piece of metal or jointless coils punched from sheet metal. The next article will describe a number of such windings.

A New Boiler Steel and Intercrystalline Cracks

Low-carbon boiler steel in use today is frequently sensitive to an embrittling action produced by cold work followed by heating to temperatures below that required for proper annealing. A soft ductile boiler steel which can better withstand the effect of cold deformation during the fabrication and operation of the boiler is, therefore, of the greatest value. Recently efforts to produce such a steel have been successful. The cause of the typical intercrystalline cracks found in embrittled boiler steel has also been the subject of further investigation.

These two subjects—experiments with new boiler steel and the cause of intercrystalline cracks—were discussed at two meetings recently held in Europe—the annual meeting of the Association of Steam Boiler Inspectors (Allgem. Verband d.d. Dampfkessel-Ueberwachungs-Vereine) at Zürich, Switzerland, on Sept. 7, as well as the meeting of the Association of Large Steam Boiler Plants (Vereinigung der Grosskesselbesitzer) at Cassel, Germany, on Sept. 17, 1926.

Professor Baumann (of the Material Testing Station, Stuttgart) at the Zürich meeting showed lantern slides of intercrystalline cracks which he produced in the laboratory as well as cases of such cracked steel parts which had failed in actual service. None of these specimens was in contact with caustic soda and the laboratory specimens had not even come into contact with water. This evidence, therefore, would indicate that the presence of caustic soda is not essential to the formation of intercrystalline cracks.

Professor Baumann also reported on his experiments to determine what concentration of caustic soda may be expected to take place in the interstices of riveted seams. The assumption has been made that the solution concentrates inside the boiler seams to great strengths, irrespective of the concentration of the main body of the water in the boiler. The author's results indicate that the concentration in the interstices of seams will not, even at high ratings, exceed about three times the concentration in the main body of boiler water.

The results of notched-bar impact tests were also reported by Professor Baumann. These he made on the special boiler steel (0.13 per cent C, and not an alloy steel) as compared with similar tests on standard steel. The tests were made with steel specimens (a) in the original condition and (b) after cold deformation and heating to 200 deg. C. The impact figures are a measure of sensitiveness to the embrittling effect. The results, expressed in absorbed energy in kg.m. per sq.cm. were as follows:

Standard Steel—Original, 20 (932 ft.-lb. per sq.in.); after deformation, 2.5–3.6 (116 to 168 ft.-lb. per sq.in.).

Special Steel—Original, 38 (1,771 ft.-lb. per sq.in.); after deformation 28.7–28.9 (1,337 to 1,348 ft.-lb. per sq.in.).

Dr. A. Fry, of the Krupp Works, the manufacturers of this "special" steel, reported at the Cassel meeting the results of further experiments made by him on this steel. These were similar to those of Mr. Jones (reported in the Trans. of Faraday Soc., Vol. XVII) and by Professor Parr and Mr. Straub (*Power*, June 29, 1926, p. 994). Specimens of standard and of the "special" steel were bent cold and then heated in concentrated caustic soda solutions. The results showed the superiority of the special steel in retaining its elasticity and in being free from any cracks after prolonged exposure to concentrated hot caustic solutions as compared with the standard steel specimens which were found to be sensitive at the points where the stresses were highest.

Doctor Guilleaume reported in detail on the results of examination of steel which had failed in service. These examinations had been made by several independent testing stations at the request of the "Association of Large Steam Boiler Plants." In all cases the failures were traced to thermal and mechanical causes. In no case did it appear that caustic soda had played any part in the development of the fractures. The cold deformation followed by heating to which the material had been subjected during the fabrication and operation of the boilers, as evidenced by the crystal deformations and large size of crystals seen under the microscope, explained the failures.

Professor Thiel of the University of Marburg reported the results of experiments, made by him at the request of the "Association of Large Steam Boiler Plants," to determine what influence caustic soda may have as an accelerating agent. Comparative tests were made with steel in powder form (filings from boiler plates) in caustic soda solutions as against identical specimens in pure distilled water. The paper reported no difference in effect on the steel, whether the pure water was used or whether caustic soda solution employed of a strength equal to the maximum concentration which Professor Baumann found it possible to reach in the interstices of seams of boilers properly made and operated. More general adoption of such low-carbon boiler steel may be expected.

Growth of Welding in Plant Construction

Exemplified by New Gould Street Station in Baltimore

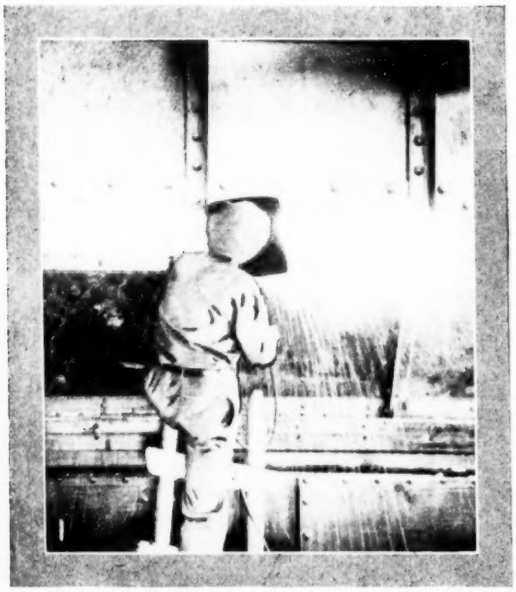


Fig. 1—Sealing joints with the electric arc

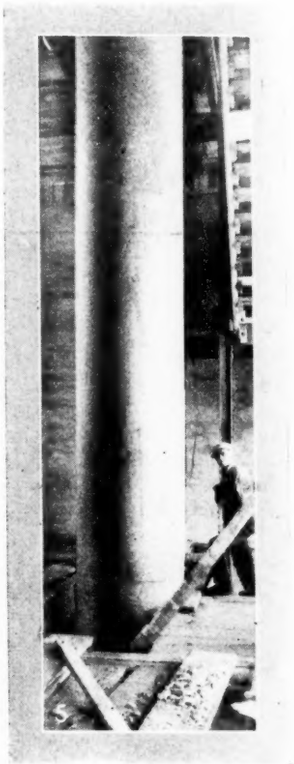
Fig. 2—Arc-welding pulverized-coal bunker to prevent sifting

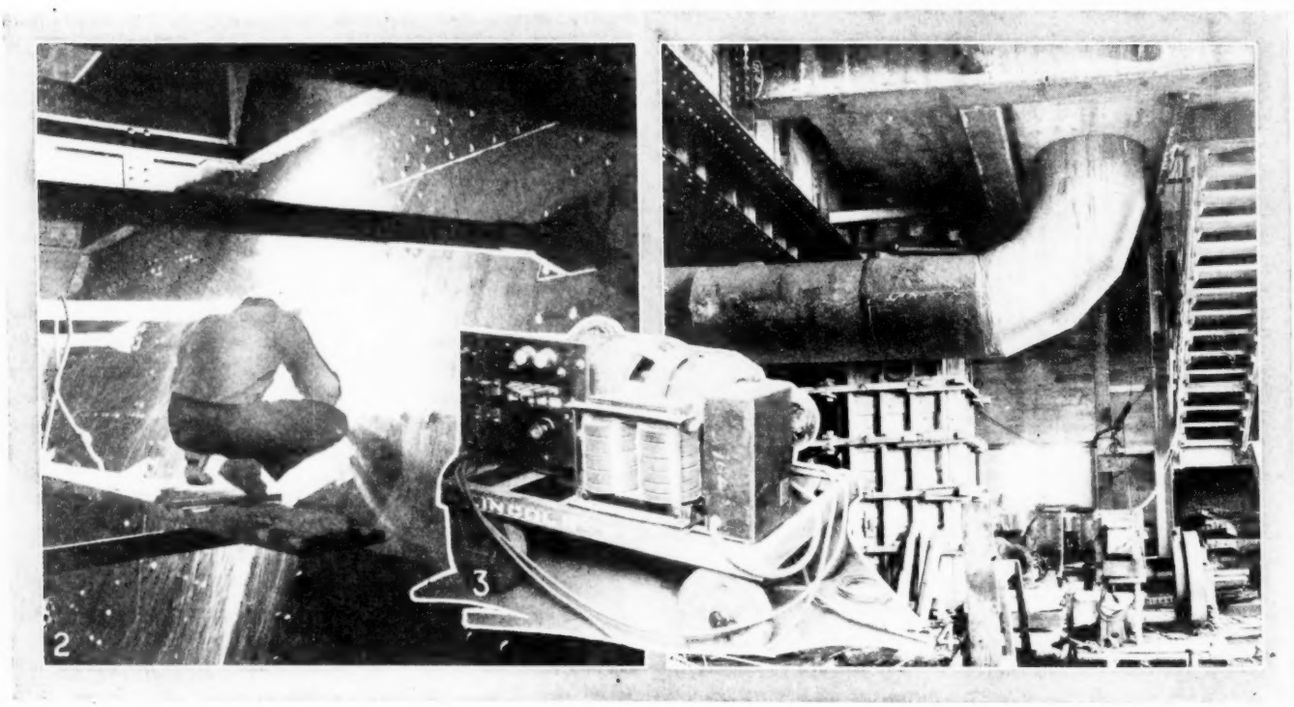
Fig. 3—Arc-welding outfit

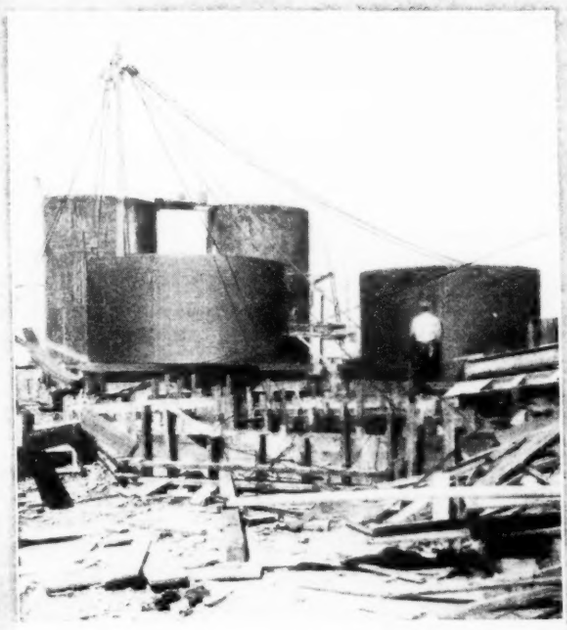
Figs. 4 & 5—Welded atmospheric line

AS AN outstanding example of the growing use of welding in the power field the new Gould Street Station of the Consolidated Gas, Electric Light & Power Co. in Baltimore is of particular interest. The accompanying photographs were taken recently by a member of the *Power* staff.

A partial list of welding applications in this plant follows: All piping in the station, including high-pressure and low-pressure steam lines, atmospheric relief, feed water, service water, etc.; fins on tubes of furnace water walls; stacks; air ducts; bleeder heaters (shells, tube sheets and connections); seal welds on roof tanks, breechings and pulverized-coal bunkers. Welding has been used for years at the Westport Station of the Consolidated Gas, Electric Light & Power Company under the supervision of A. L. Penniman, superintendent of power stations. Its extensive use for new construction at Gould Street is a natural outgrowth of this experience.







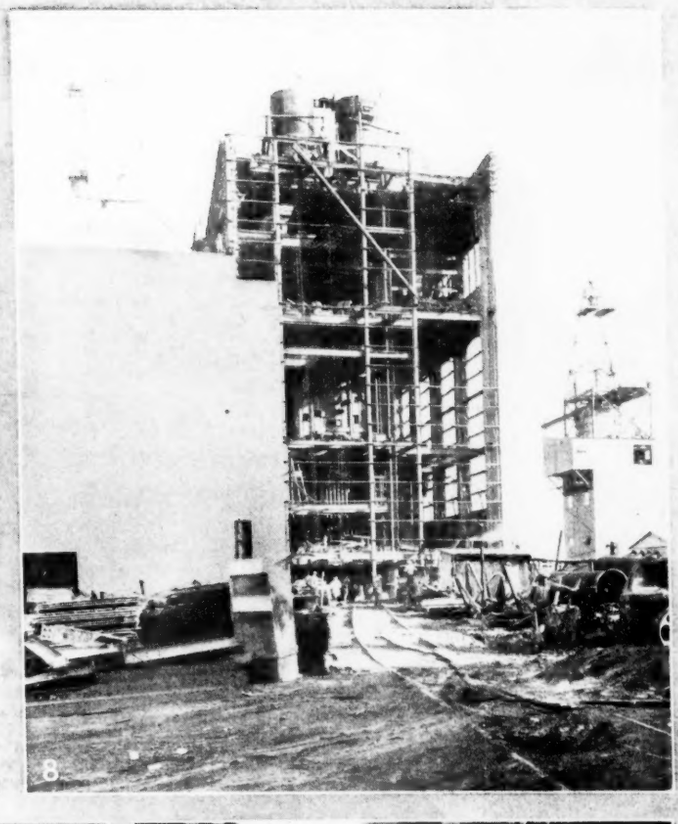
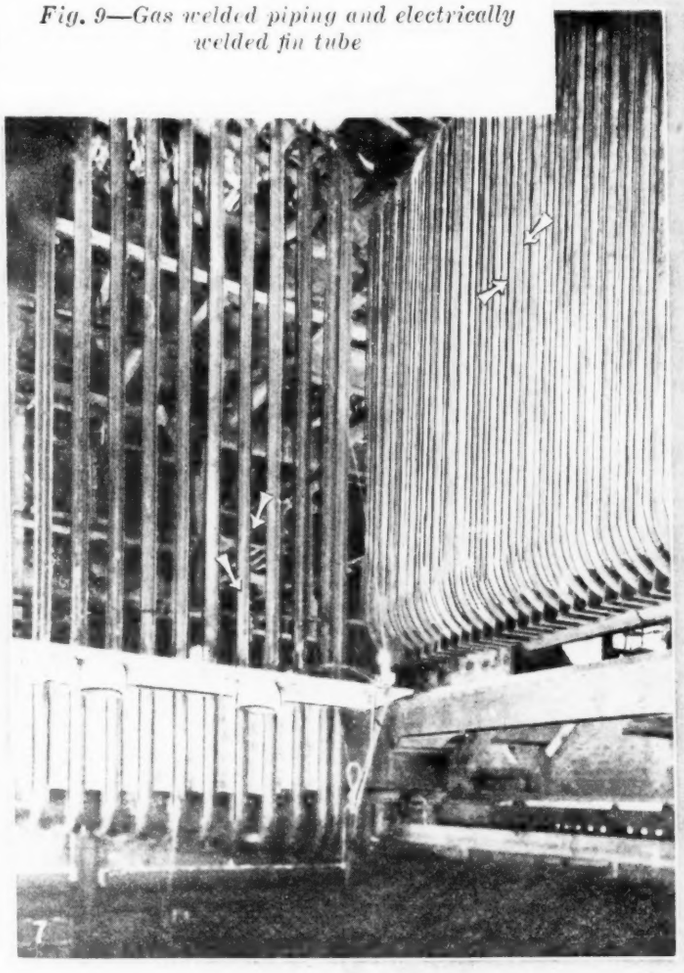


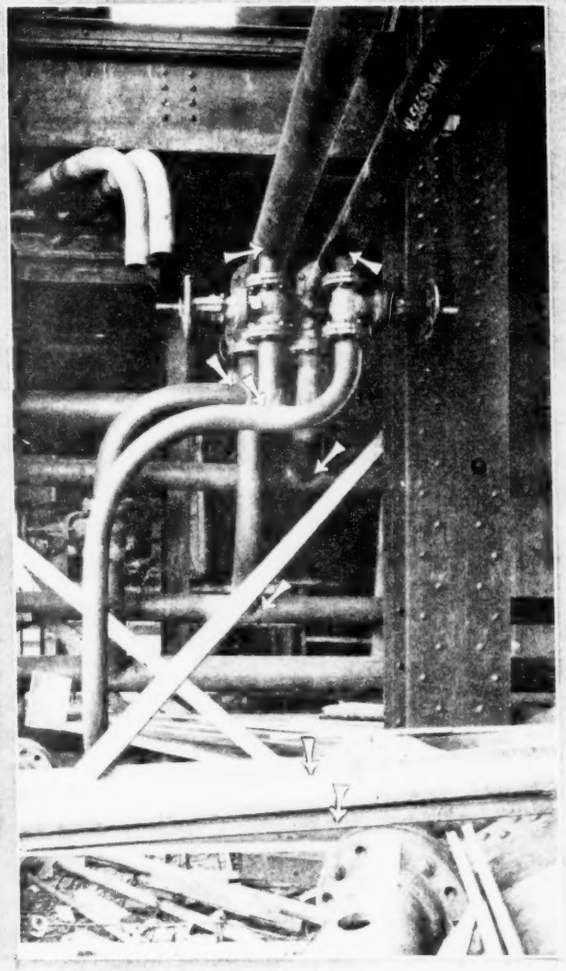
Fig. 6—Roof tanks are seal-welded

Fig. 7—Water-walled furnace with electrically welded fin tubes

Fig. 8—General view of station

Fig. 9—Gas welded piping and electrically welded fin tube





How the L. & N. Automatic Combustion Control System Operates

A SIMPLE explanation of how the various pieces of equipment making up the control system operate, and how these function to control automatically the operation of a single boiler or a group of boilers.

MORE attention has been given to automatic control of the combustion process in boiler furnaces in the last ten years than during all time previous, and, as might be expected, greater progress has been made in the art of boiler-plant control than for any previous period. Conditions to give best combustion in a furnace, after once adjusted, do not remain constant, but are affected by the changes of load on the boiler, quality of fuel, condition of the fire, etc. Therefore, if the most economical combustion is to be maintained, means must be provided to maintain automatically the correct ratio between the fuel and air supply, to meet the steam demands. Where there is a battery of boilers carrying a common load, the control system should also automatically maintain the division of load among the boilers. An automatic control system of the type has been developed by the Leeds & Northrup Co., which is electrically operated.

Operating Medium Used

In this system the operating medium is a direct electric current, to which the combustion rate is proportioned. When the electric current is adjusted to 10 per cent of normal in the control system, the fuel and air supply will be automatically adjusted to this percentage. An increase to 30 per cent of electric current produces a corresponding increase in the fuel and air supply.

This current adjustment is produced by a master regulator operated by changes in steam pressure, Fig. 2. At *B* is a diaphragm, through which steam pressure moves the arm *A* over the stationary contacts *C* and cuts the resistance units in and out of the circuit in response to the changes in steam pressure. When the steam pressure is at a maximum value, the resistance is all in the circuit and the control current is at a minimum. As the steam pressure falls, resistance is gradually cut out of circuit and the combustion rates increased, until the maximum electric current is reached at the lowest pressure for which the regulator is set and the maximum combustion rate is reached. An adjustable multiplying lever ratio is provided between the diaphragm *B* and the brush arm *A*, which makes possible varying the steam-pressure change required to effect full motion of the regulator, so as to best accord with individual plant conditions. In general the regulator varies the current value in steps of 2 per cent over the control range.

Operation of Control System

Fig. 3 shows the general arrangement of a control equipment of this type as installed in the plant of the Staten Island Edison Co., by The J. G. White Engineering Corp., New York City. In this diagram the master controller is connected to the steam header. Assume that the load increases on the boiler. This

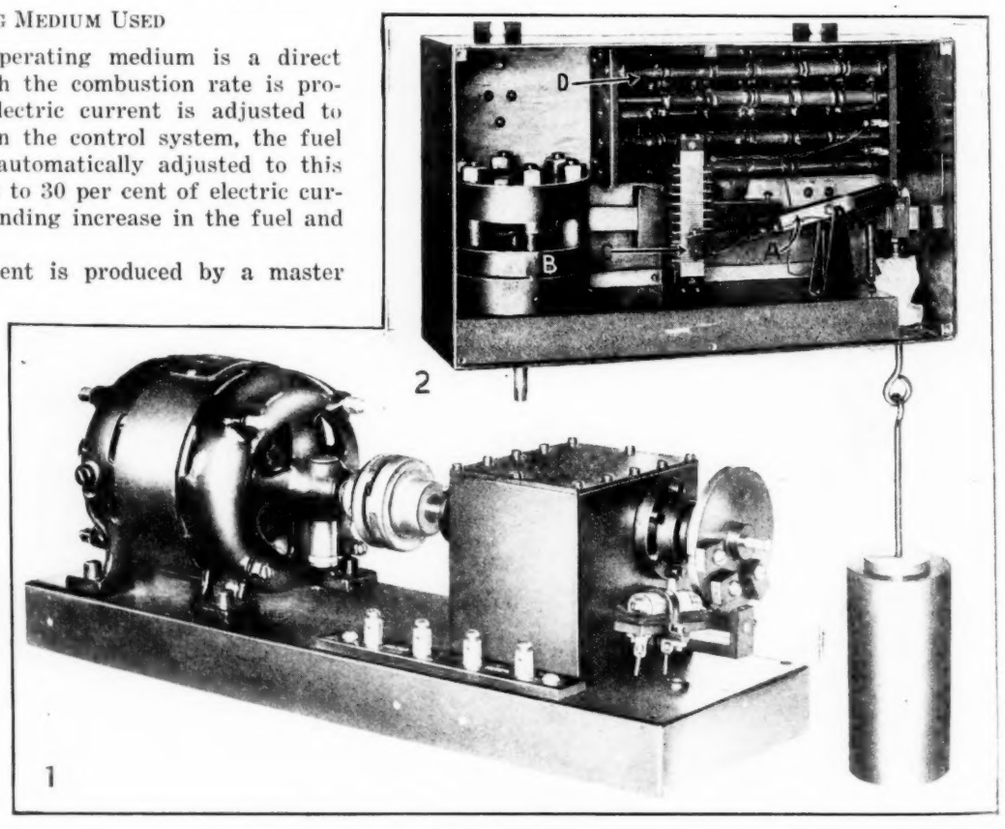


Fig. 1 — Motor-driven interrupter, with protecting cover removed

The interrupter is in series with the relays of the fan-motor controller and acts in conjunction with an electrical notching device to cause the drum controller to move one notch at a time.

Fig. 2 — Master controller, which is a rheostat operated by the steam pressure acting on a loaded diaphragm

will cause a drop in pressure in the steam header, which will be transmitted to the master regulator and cause it to operate to increase the flow of current to the stoker and the air-flow controllers. The increased current to the stoker controller causes it to function and move the stoker-motor controller to speed this motor up and feed more coal to the furnace. At the same time the air-flow controller operates to cause the uptake damper drive to function and move the damper toward the open position.

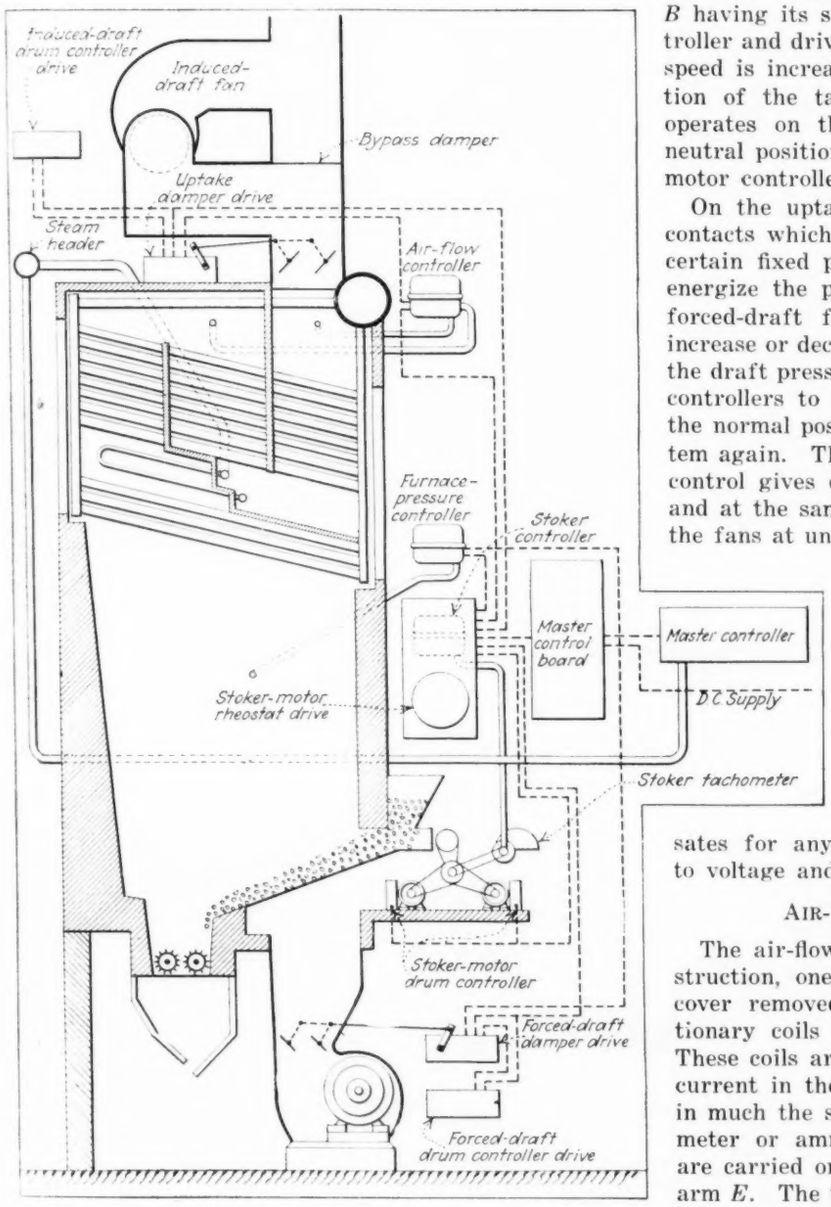


Fig. 3 — Diagram of automatic combustion control system as applied to a large boiler

The operating medium is a direct electric current, which is varied by a master regulator and the combustion rate is automatically adjusted to be proportional to the value of the current in the system.

Opening the uptake damper reduces the pressure over the fire and brings the furnace-pressure regulator into operation, which energizes the forced-draft damper drive, causing it to open the damper, increase the flow of air through the fuel bed and restore the furnace pressure. When the damper has been opened to a point where the furnace pressure has been restored to normal, the furnace-pressure regulator returns to a neutral position and stops further motion of the forced-draft damper.

The air-flow controller is connected to the last two passes of the boiler. Opening the dampers increases the volume of gas through the boiler and the pressure differential between the different passes. This change in pressure between the second and last pass acts on the air-flow controller to return it to a neutral position and stop the motion of the uptake damper.

Connected to the stoker controller is what is called the stoker tachometer, Fig. 7, which is a small blower *B* having its suction side connected to the stoker controller and driven from the stoker shaft. As the stoker speed is increased, the pressure is reduced in the suction of the tachometer. This reduction in pressure operates on the stoker controller to return it to a neutral position and stop further motion of the stoker motor controller.

On the uptake and forced-draft damper drives are contacts which close when these dampers move beyond certain fixed points. When these contacts close, they energize the power units on the induced-draft or the forced-draft fans, as the case may be, and either increase or decrease the speed of the fan. This changes the draft pressure in a direction that causes the damper controllers to operate and return the dampers toward the normal position and restore equilibrium in the system again. This combination of damper and fan-speed control gives close regulation of the gas and air flow and at the same time does not waste power or operate the fans at unnecessarily high speeds. It also compensates for any changes in the speed of the fans due to voltage and frequency changes.

Air-Flow and Stoker Controllers

The air-flow and stoker controllers are alike in construction, one of which is shown in Fig. 5 with the cover removed. This controller consists of two stationary coils *A*, between which is a movable coil *B*. These coils are connected to operate on the changes of current in the circuit set up by the master controller, in much the same way as in a dynamometer-type voltmeter or ammeter. Movable coil *B* and its support are carried on knife-edges and are attached to contact arm *E*. The two horizontal arms of the tilting support carry a pressure bell and a compensating float *C*, respectively.

With a given current in the coils and pressure in the bell, the movable coil will be in a balanced position between the two stationary coils, which will also put arm *E* in a mid-position between the two sets of contacts at *D*. Either a change in current or a change in air pressure will disturb this balance and the arm *E* will be moved to the right or left to close the contacts. For example, a drop in steam pressure will, as previously explained, cause the master controller to increase the actuating current in the controller coils. If the controller in Fig. 5 was used on air flow, it would move coil *B* to the right and close the right-hand contacts, which would actuate the uptake-damper controller to

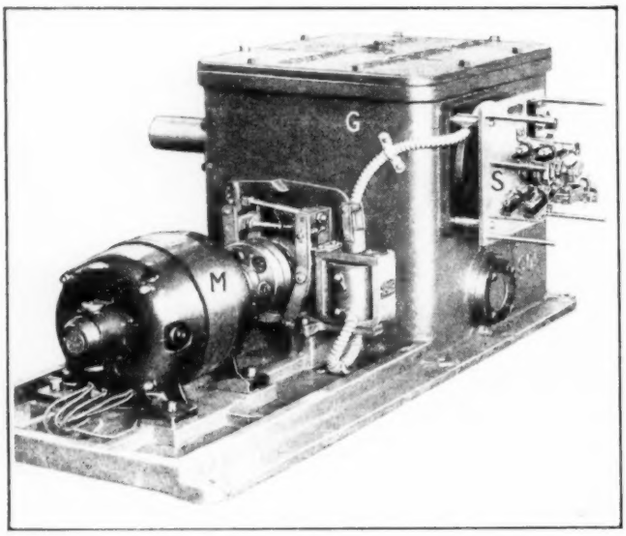


Fig. 4—Motor drive unit for operating the motor controller and dampers (protecting cover removed)

start opening this damper. Opening the damper causes an increase in the pressure drop across the boiler passes, which acts on the controller bell to move coil *B* to a balanced position and open its contacts to prevent further movement of the dampers. One draft connection communicates with the interior of the bell and the other with the space enclosed by the controller cover.

A similar action takes place on the stoker controller, only in this case an increase in speed of the stoker would cause a decrease in the tachometer fan suction pressure. This decrease in pressure would act to restore the controller to a balanced position, as did an increase in pressure difference with the damper controller. In the stoker controller the space above the bell is connected to atmosphere.

In a dynamometer-type meter, within certain limits, the torque developed by the movable coil varies as the square of the current. This is also true of the force acting upon the movable coil in the damper and stoker controllers. In this case, however, the coil remains in practically a fixed position, consequently the force acting on the movable coil varies over the entire operating range as the square of the current. The pressure drop across the boiler varies as the square of the gas velocity and the suction developed by the tachometer varies as the square of its speed, therefore the two forces acting on each controller both vary according to the same law.

From the foregoing it is evident that the air-flow and stoker controllers are really electric air-flow meters adapted to control purposes. Instead of giving indications of air-flow values, their function is to hold air flow or stoker speed at certain values as determined by changes in steam pressure acting on the master controller.

Extending through the three coils in the controller is an iron core. By moving this core, the resultant force acting on the movable coil can be changed. This adjustment, which can be effected by turning a knob outside the controller case, permits a change of the ratio of air flow or stoker speed to the control current over a range of 30 per cent. The control range is variable to meet the requirements of any individual installation by changes in the pressure bell sizes.

The coils of the air-flow controller and those of the fuel-feed controller carry a common current, so that a given percentage change in the control current produces an equal change in both air and stoker speed. The coils are designed for a maximum working current of about 0.5 ampere.

Constant Furnace-Pressure Control

A somewhat simplified control is in use for constant furnace pressure, such as that shown in Fig. 6. In this controller the electric coils have been omitted and a spiral spring *S* attached to the lever *L* that operates the movable contact arm *E*. The action of this spring is opposed by a pressure bell connected to the furnace at a point over the fire. The space above the bell is connected to atmosphere. When the pressure over the fire changes, this change is transmitted to the controller though the pressure bell, which causes the contacts to close for moving the forced-draft damper in the correct direction to restore the furnace pressure and put the controller in balance.

The control unit, Fig. 6, is not influenced by the control current. When an over-fire pressure varying with the load is desired, a controller is used similar to the air-flow control, Fig. 5. The coils are connected in series with the coils of the air-flow and fuel-feed controllers.

A motor-driven unit is used to adjust the dampers, motor controller, or whatever means of controlling air flow and fuel feed may be employed. The drive unit,

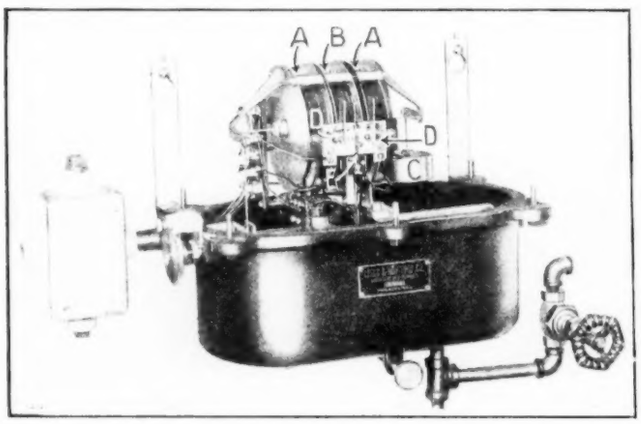


Fig. 5—Air-flow or stoker controller

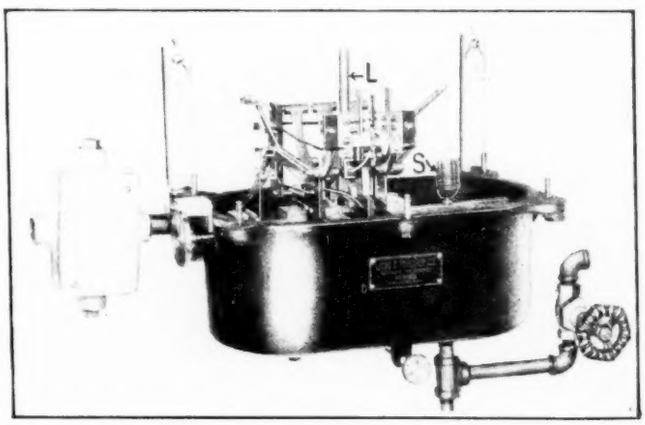


Fig. 6—Furnace-pressure regulator

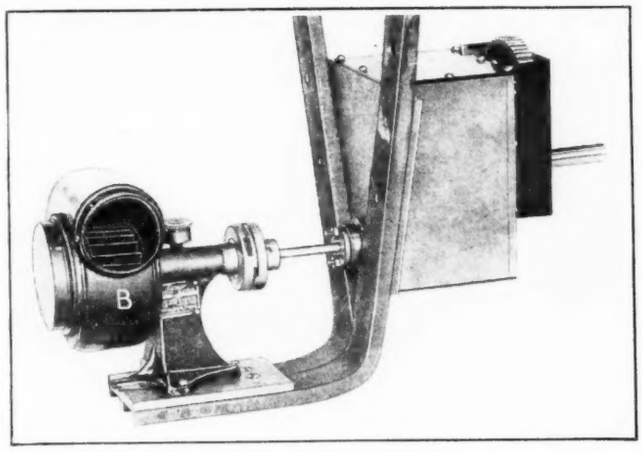


Fig. 7—Stoker tachometer, consisting of a small blower B, the suction side of which is connected to the stoker controller

Fig. 4, consists of an electric motor *M* with a large ratio reduction gear *G* that results in a comparatively slow motion of the driving arm or sprocket, connecting the reduction gear to the damper or controller. Mercury limit-switches *S* are provided on the drive units so that the range of travel can be conveniently adjusted to correspond with that of the driven control. Two forms of this drive are used, one with a horizontal and the other with a vertical drive shaft.

Master Controller for Group of Boilers

There is a master control panel for the group of boilers and an individual control panel for each boiler. On the master control panel is mounted the master controller, Fig. 2, a master hand rheostat from which the combustion rate of all the boilers in service may be changed as a group; a master combustion-rate indicator; and a selector switch for changing from automatic to master hand control or vice versa.

Each boiler may be switched to master control, individual control, automatic pull-button control, and off by a selector switch on the individual control panels.

Under individual automatic control the fuel-air ratio and the furnace pressure are held constant automatically, but the operator can vary the combustion rate at will by turning the boiler hand rheostat.

On these panels are also mounted a motor-driven stoker motor rheostat, Fig. 8, which is operated from the master controller, a manually operated rheostat for varying the load on the boiler, independently of the master controller, when the boiler is under automatic control; a selector switch; and four single-pole double-throw pull-button switches for hand control of fans and dampers.

When the selector switch is set for pull-switch position, the operator is given centralized but unrelated means for controlling all factors affecting air flow. The stoker motors with their drum controllers are mounted on the boiler-room floor and can be operated directly by hand whenever desired.

The motor-driven stoker-motor field rheostat, Fig. 8, may be disengaged from the driving motor and turned by hand when desired. A transfer switch is provided for cutting the rheostat into the field of either stoker motor, one of the motors being a spare, at each boiler. Over the drum controller at each motor, used for starting and ordinary hand operation, is a signal lamp that will light only when the automatic field rheostat is all cut out, so that the motors may be started safely.

At the lower rating of the boilers the induced-draft fans are not operated and the stack draft is controlled entirely by the uptake dampers. When these dampers reach their extreme positions, signal lamps on the individual panels light and indicate to the operator when to start and stop the fans, under automatic control, or to change its speed when under pull-button control. At the higher ratings the stack draft is controlled by a combination of fan-speed adjustment and damper position, as previously explained.

In circuit with the relays of the fan-controller motor drive is an interrupter, Fig. 1, on the master control board. This acts in conjunction with an electrical notching device on the drive unit itself to cause the drum controller on the fan motor to move one step at a time, with a short pause following each step to allow the fan speed to attain a value corresponding to the position of the controller. This action prevents stopping of the controller between steps and hunting between the fan and damper.

In this control system particular attention has been given to the design of the parts so that rapid response to changes in load may be secured without hunting of the equipment. Economy of power for the fans has had careful consideration, and the system provides for regulating the fan speeds so as to keep the damper positions within economical operating limits. The various control units are related to one another through comparatively simple electrical circuits, but the system operates with equal satisfaction whether the auxiliaries are electrically or mechanically driven.

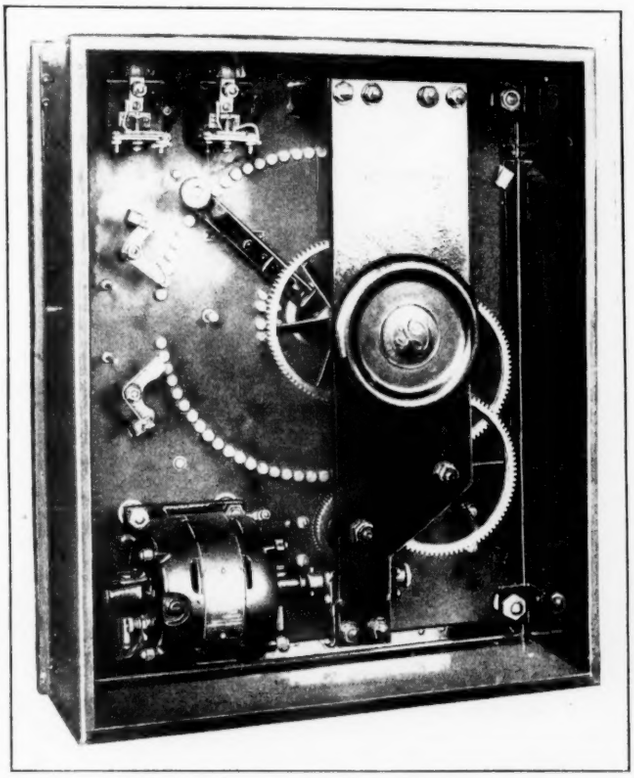


Fig. 8—Motor-operated stoker-motor field rheostat, with protecting cover removed

What the Merit System Is Doing for Operating Engineers

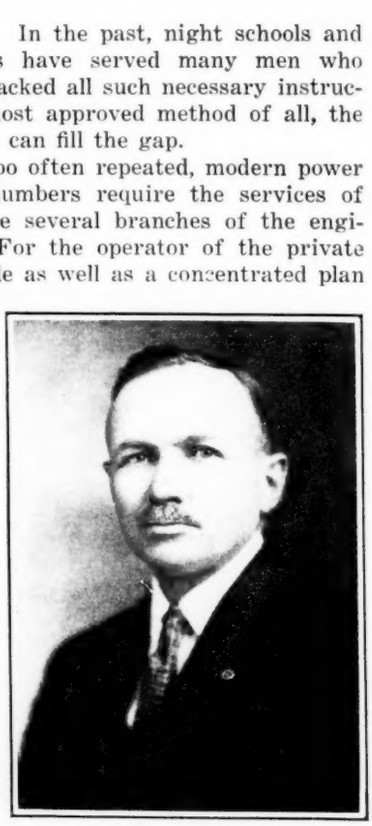
TRAINED by experience and long practice, the operating engineer often feels the need of a well guided education in the broader fundamentals of his field. The N.A.S.E. has a remedy in the Merit system, a course of study which for two years has supplied hundreds of men with such an education. Let it be a boon to thousands more!

OF LATE the position of the operating engineer has gradually been growing more difficult. In both the central station and the industrial plant higher steam pressures and improvements in equipment have made the operating problem more complex. As a result the average operating man has often been hard beset by the difficulties of keeping abreast with the changing conditions in his field. Moreover, increased efficiency in central-station practice has made it all the more necessary that the private plant be operated with utmost economy, if it is to survive. This has added a management problem to the duties of the operating man, and he must be capable of analyzing the economic problem of his plant. To make matters worse, the license laws in the various cities and states do not cover the situation as a whole, for the reason that the majority of the statutes recognize only boiler-room and engine-room operation. What the laws of the neighboring state or the second one down the line may require of him, should he leave one job for another, is often equally puzzling.

Garrett Burgess

Lacking some centralized assistance, the engineer is, accordingly, much like a ship's master without a chart; for he continually finds himself in the worrisome situation of one who is confronted with the daily performance of an important task without the equipment of adequate knowledge, either general or specific. A trained worker with his hands and drilled by experience, he yet has the urgent need of a disciplined mental training in the fundamentals of his field. Frequently, the result is that he is depressed by his failure to advance, and is consequently hampered by his employer's lack of confidence in his ability. He has, under those circumstances, often failed to realize that the way of progress is the way of a broader and modernized engineering education. In the past, night schools and correspondence courses have served many men who otherwise would have lacked all such necessary instruction. Now, and the most approved method of all, the N.A.S.E. Merit System can fill the gap.

As can be scarcely too often repeated, modern power plants in increasing numbers require the services of operators skilled in the several branches of the engineering department. For the operator of the private plant this means a wide as well as a concentrated plan of study. Whether the engineer fits himself for the business of lowering production costs is mainly, as the phrase goes, "up to him." Shall he keep a firm footing, proving that *he* is the capable man for the job, or shall his lack of ability serve only as a strong argument for his employer to close the plant and purchase power from the central station?



Frederick L. Ray

Decidedly, there can be found no better remedy than that of a sound and up-to-the-minute training in the approved ways and means toward greater economy.

The principal aim of the National Association of Stationary Engineers has been, since its founding, the betterment of its members through a thorough and inclusive system of education, but for many years no plan along national lines could be made feasible. Toward the end of 1923, however, the Michigan State Association considered and put into operation the Merit system, under the founding and active supervision of Garrett Burgess. And now, after three years of devoted activity on the part of Mr. Burgess, the Merit system has recently passed its first national birthday, having been adopted by the National Association on Sept. 3, 1925, at the annual convention held at St. Paul, when Mr. Burgess was elected national president. Side by side with the work of Mr. Burgess should be mentioned that of Frederick L. Ray, who, as chairman of the National Educational Committee, has earned credit for unstinted effort in bringing the plan to its accomplishment. Mr. Ray's committee was vested with the direct charge of the management of the system. Six weeks ago the steady progress of this endeavor during the last year was reported, and a handsome silver cup was presented to Mr. Ray by President Burgess, as a testimonial of his excellent and continued service in the work. The sum of $10,000 was voted the Educational Committee, and an appeal was made to every member

of the Association for fresh and renewed efforts to assure the complete success of the plan.

At this time, therefore, it may be of advantage to many members of the N.A.S.E. and other engineers outside the Society, to outline briefly the organization of the plan and its operation.

The Merit system, then, is a course of study covering eight phases of power-plant practice and designed to supplement the engineer's practical experience with a sound fundamental knowledge, combining the scientific laws in this field with the latest approved methods of operation. The student applying for a license would find this course of substantial assistance. Any member of the N.A.S.E. may enroll for study. The course is so prepared that the student may undertake first that branch which most appeals to him; but, as a preliminary, he must pass successfully the set of 500 questions on mathematics applied to general engineering. Each of the ten subjects — Steam, Heat, Refrigeration, Combustion, Heating and Ventilating, Internal Combustion and Oil Engines, Mechanical and Hydraulic, Electrical, Portable and Hoisting Engines, and Hotel and Building Engineering and Supervising Engineering—consists of 500 problems or questions. No answers to these are supplied, but all queries in good faith and resulting from difficulties in their solution are readily received. Tuition costs $6, $5 for the course book and a $1 charge for the certificate on the completion of the course. Should a student desire to undertake one or more subjects after the certification of his first, no further charge is made beyond that of $1 for each certificate. Passage of the mathematical preliminary questions and the examination for a Technical Certificate require a rating of not less than 90 per cent.

Conditions of entrance are extremely simple. Any member of the association of at least five years' engineering experience and who has enrolled in the course may make application for examination for a Practical Certificate. Three members of the examining board make the test. If this is passed a certificate of merit is awarded, and if an applicant is successful in both the technical and practical examinations, a merit certificate will indicate his competency. Should a practical engineer who has had no technical training desire, however, to waive the written examination, he may be awarded a Practical Certificate, upon the recommendation that he has had the required five years' experience and having passed, in addition, the examining committee's test. The Certificate of Merit shall, then, be issued to any member who has qualified upon the recommendation of three board examiners. Through the chairman of this board the application, properly filled out and indicating the certificate applied for, is sent to the national secretary. All certificates are signed by the national president, national secretary, chief examiner and the chairman of the educational committee, as well as by the examiners. As soon as initiated, a member of the Association may enroll for study. After one year's membership he may be examined in his district.

In charge of the Merit system, the National Educational Committee controls all educational subcommittees and examining boards and prepares all lessons and papers and establishes the necessary regulations. It is composed of three members appointed by the national president, and it, in turn, appoints one subcommittee for each branch of study covered in the Merit system. This subcommittee corrects and marks all papers.

In co-operation with the Merit system certificate plan an information service department is doing good work along educational lines. Once a man has secured his certificate, this information service is a strong inducement to maintain his active interest in the organization, and to keep up to the minute in his special field. With this ideal in view the National Editor has assumed responsibility for the proper function of this department. A full-time instructor has been employed by the Educational Committee, and $10,000 voted for this year's work.

The Technical Certificate—the Practical Is Similar in Appearance

Outstanding among many prominent engineers throughout the country, and famed for his masterly handling of national affairs, both governmental and industrial, Secretary of Commerce Hoover has heartily indorsed the Merit system. In a letter to Mr. Burgess on Jan. 28, 1925, Secretary Hoover commended the adoption of the plan as a "highly constructive step which will tend to develop the technical standing and public recognition of the importance of the great body of men who comprise our stationary engineers."

As an ambitious movement of the National Association of Stationary Engineers, the Merit system has passed its growing pains. It is already experiencing a healthy progress. It must realize the complete success it justly deserves. With the active backing of N.A.S.E. men, that is certain. This is the good wish of *Power*.

Any Fireman Can Understand How the Refrigerating Plant Operates

By G. GROW

ALMOST any layman can explain, more or less comprehensively, why a steam engine turns over and in this age of millions of automobiles, every ten-year-old boy understands a gasoline engine. On the other hand, many who are operating refrigerating plants do not fully grasp the basic principles of the refrigerating cycle. As a consequence their procedure in manipulating the several pieces of apparatus is based on experience or instructions, and, of course, when something beyond the usual happens, past performance fails to supply them with the proper cue for action.

BROADLY speaking, the cycle of events in the refrigerating system is in principle identical with the steam power plant cycle, with the exception that the sequence is reversed, power being obtained in the latter at the expenditure of much heat, while in the refrigerating system heat is the output at the expenditure of a little power. The actions may be illustrated by two similar diagrams. In Fig. 1 we have a quantity of water whose volume is represented by the distance *OY* and under a pressure indicated by *OZ*, of, say, 0 gage. It is assumed to fill the clearance space between the cylinder head and piston, as indicated at *A*.

Imagine that heat be applied to the bottom of the

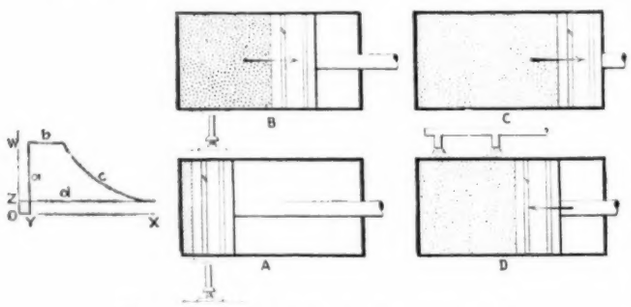


Fig. 1—A diagram of a steam cycle

cylinder while the piston is held by a resistance. Water attempts to expand as it warms up and, as this is impossible, the pressure rises. When this reaches a value represented by height *OW*, such that the force holding the piston immovable is just equal to the pressure exerted by the warm water, further application of heat causes the water to evaporate and the piston is forced along its stroke, as indicated by the line *b*, until all the water is evaporated. The piston is now in the position shown as *B*, and on further movement of the piston, the steam expands, its pressure and volume conditions being indicated by the line *c* until the end of the stroke is reached. This latter position is illustrated at *C*. If, now, cold water be sprayed on the cylinder, the steam will condense and the piston can be moved on its return stroke until, when the stroke is completed, all the steam has been condensed into water and the cycle may be repeated.

It will be readily appreciated that if the steam-making and condensing were actually carried out within the engine cylinder, a very impractical machine would result. Consequently, as illustrated in Fig. 2, the evaporation of water is performed in a boiler from which the engine receives its steam supply, and the expanded fluid is rejected to a condenser, where it is reduced back to water by the use of a supply of cold water. After the pump forces it back into the boiler, it is ready to start on a new cycle.

Observe, now, how similar is the refrigerating cycle. Assume that within the clearance space of the compressor cylinder, Fig. 3, there is a quantity of liquid ammonia having a volume represented by the length *OY* and at a pressure *OZ* of, say, 15 lb. gage, at which pressure ammonia will boil when raised to a temperature of 1 deg. F. The liquid ammonia will begin to absorb heat through the cylinder walls, and if the piston be moved at a rate to accommodate the warming ammonia, as at *A*, the pressure will remain at 15 lb.

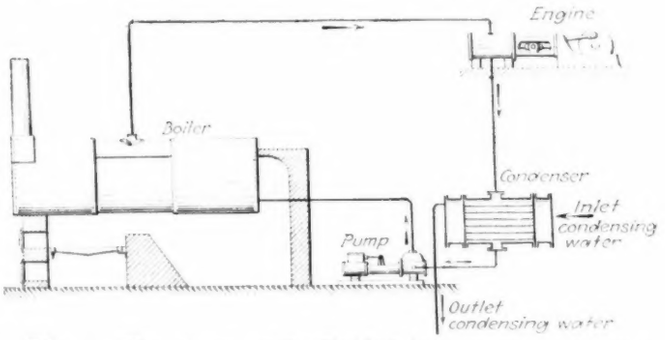


Fig. 2—The steam cycle divided into component parts

and evaporation will take place. When the end of the stroke is reached, as indicated at *D*, all the fluid will be a vapor exerting 15 lb. gage pressure and some of the heat of the room will be contained in the ammonia vapor, having been absorbed by the compressor metal as fast as the latter gave up its heat to the boiling ammonia.

If, now, the piston be moved toward the head end, as at *C*, this vapor will be compressed and its pressure and temperature raised. At the end of the compression, indicated by the piston position in *B*, the pressure is, say, 140 lb. gage, and if cold water at 70 deg. F. is showered on the cylinder, the vapor will condense back into liquid as the piston continues

along the line *b*, for at 140 lb. gage ammonia will condense if cooled below 80 deg. F. At the end of the condensing period *b* the fluid is all liquid and a flow of colder water will chill it back to its original condition of pressure and volume indicated by the cross-hatched section of the diagram. This is the refrigeration cycle and differs from the steam cycle as shown below:

State	Steam	Refrigeration
Evaporation	High temperature High pressure	Low temperature Low pressure
Pressure change	Expansion	Compression
Condensation	Low pressure	High pressure

As with the steam cycle, it would not be practical to evaporate the liquid ammonia in the compression cylinder, for the purpose of the whole operation is to absorb the heat from a refrigerator or ice tank, so that the latter can be kept at a low temperature. Neither is it feasible to condense the ammonia vapor inside the cylinder. These portions of the cycle are carried out in more adaptable apparatus and, as shown in Fig. 4, we have the evaporating coils inside a refrigerator box, a compressor and a separate condenser. These parts in steam parlance could be termed a boiler (the evaporating coils), a reversed engine (the compressor) and the condenser. In addition a receiver is interposed between the condenser and evaporating coil, which is comparable to the steam-plant hotwell or, in case of a non-condensing plant, to the heater. No feed pump is needed to put the ammonia from the receiver into the coils, since the receiver pressure is high, from 120 to 200 lb., and the evaporator pressure is from 0 to 30 lb. gage, depending upon the refrigeration temperature desired. With the refrigerating cycle found to be comparable to the steam-plant cycle, let us see if the control is at all similar.

In the steam plant a heavy fire causes the steam pressure to rise and part escapes either by the pop safety valve or through an increased demand by the

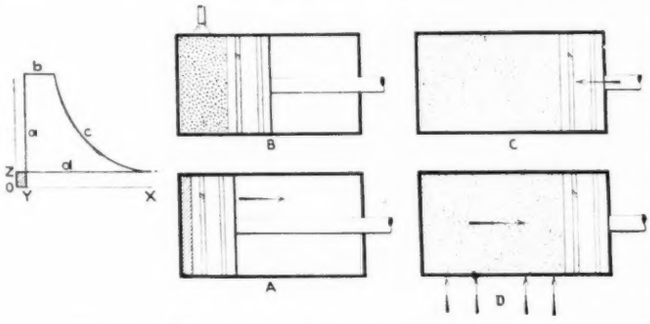


Fig. 3—How the refrigerating cycle works

engine. In fact, the usual procedure is to fire heavy only when the engine requires more steam. To replace the water generated into steam, the fuel pump is speeded up, or in case of temporary high steam consumption the pump speed may be unaltered and the water level in the boiler allowed to drop below normal.

In the refrigerating plant, through the placing of filled cans in the brine tank or the storage of new supplies of food, a larger amount of heat is given off to the evaporating coils. More liquid ammonia is evaporated, and either the evaporation pressure rises or the compressor is speeded up so that it can remove the ammonia vapor as fast as it is generated. In the latter event, the coil pressure stays constant and the refrigeration temperature does not rise. In view of the more rapid boiling the supply of liquid entering the coils must be increased; this is brought about by opening the regulating cock somewhat wider.

But some will say, "Our compressors are driven by synchronous-speed motors, so we cannot vary the speed."

That is a condition faced by many and has led to the use of clearance pockets in the compressors. With constant speed and no clearance pockets the ammonia

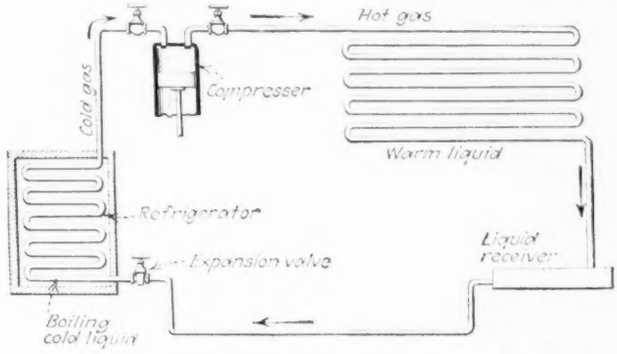


Fig. 4—Parts of the refrigerating plant as used

vapor cannot be removed as fast as it is formed by the increased amount of heat. The coil pressure will rise, and this means that the temperature of the liquid in the coil will be increased until it reaches the boiling point corresponding to the pressure. This process continues until the amount of heat that can pass through the coils with the smaller temperature difference between the refrigerator and the ammonia liquid, is just sufficient to evaporate the amount of vapor the compressor can handle. It is not surprising, then, that with the introduction of fresh stock into the refrigerator the suction pressure goes up.

The removal of more ammonia vapor, just as in the case of an increased consumption by the steam engine, requires the condenser to handle more of the fluid. The amount of cooling water must be increased or the condenser pressure will rise, as in case of the steam plant. With a higher condenser, or back, pressure an engine's output decreases, while when the refrigerating plant's head, or condenser, pressure mounts, the power required to operate the compressor is increased.

Now let us see what happens when the amount of heat to be removed from the refrigerator is below normal. When the furnace fire is low in the steam plant, the steam is generated more slowly. If the engine continues to run at a constant speed, the steam supply fails to meet the demand and the steam pressure falls.

In the refrigerating plant, unless there is enough heat in the ice box to keep up the rate of boiling in the coils, the compressor running at a constant speed withdraws the vapor faster than it is formed and the suction or coil pressure drops.

The fireman slows down the boiler-feed pump when carrying a light fire, to prevent the filling up of the steam space and the flooding of the engine with water. The refrigerating engineer must close down on the regulating or expansion cock and so diminish the flow into the coils. If he fails to take this step, the liquid "slugs" into the compressor, causing the familiar thump.

Use of High Steam Pressures and Temperatures in Central Stations*

THE highest pressures and temperatures reached in equipment in actual operation in France are 2,100 lb. and 930 deg. F. These conditions are reached in a small boiler of special design that has given no trouble. The manufacturerer is ready to undertake the construction of large boilers for central-station service under the same steam conditions. Boilers of 10,000 to 22,000 sq.ft. in actual operation have not yet exceeded 570 lb. and 770 deg., or 410 lb. and 800 deg.

Under construction or design are boilers for 710 lb. and 750 deg. and 850 lb. and 800 deg. All these firms will take orders for pressures between 700 and 1,550 lb. and temperatures up to 850 deg.

Among manufacturers of piping and valves one will accept orders for small equipment up to 3,000 lb. and 1,000 deg.; another for 2.800 lb. and 850 deg. up to 4-in. opening.

Among turbine manufacturers the Société Electro-Mécanique, French licensee for Brown-Boveri, will accept orders up to 1,400 lb. and 850 deg. in all capacities, the Société Alsacienne de Constructions Mécaniques will take orders up to 1,150 lb. and 750 deg., and the Société Rateau up to 1,400 lb. and 850 deg. in all capacities. Professor Rateau considers that the best station efficiencies should be found with steam at about 1,400 lb. at the boiler.

It is pointed out that manufacturers are evidently ready for large advances in pressures and temperatures and are merely waiting for operators to decide.

The Problem of Steam Pressures

The evolution of steam pressures has been very rapid since the war; yet, generally speaking, those who have tried high pressures have obtained satisfactory results. The troubles predicted have not materialized. Speaking from the viewpoint of a central-station operator, the reporter[1] expresses the opinion that, if any difference exists between the facility of operation under pressures of 175 to 200 lb. and of 350 lb., it is in favor of the higher pressure; and he estimates that the advantage will be still greater at considerably higher pressures.

However, a certain hesitation is evident in the progression beyond 570 lb., though the reporter considers that the step should have been made up to 850 or 1,000 lb. The reasons alleged for this hesitation are as follows:

1.—*Safety*—This may be discarded at once, for there is no longer any excuse for claiming that lower pressures are safer than higher.

2.—*Technical difficulties:* (a) *Difficulty in the separation of the steam from the water in the boiler tubes, owing to the high density of the steam.* This does not seem defendable since, even at 1,400 lb., steam is more than thirteen times lighter than the water from which it is generated, and its buoyancy is still 78.5 per cent of that of steam at 350 lb.

(b) *The high specific gravity of the steam may favor priming.* This does not seem likely, for priming depends more on the velocity of escape of the steam than on its specific gravity; and the velocity of escape of the steam will be reduced at higher pressures.

(c) *Fear of troubles with joints in piping, valves, etc.* These have proved vain.

(d) *The instability of the steam pressure.* This will be reduced, owing to its more rapid variation with the temperature at higher pressures.

3.—*Operating Efficiencies*—The claim that efficiencies will not be improved at higher pressures is not founded. The efficiency of the boiler proper may tend to decrease, owing to the higher steam temperature, but this tendency will be neutralized by means of heat exchangers placed in series with the boiler, particularly air heaters. Mechanical efficiencies of turbines are somewhat lower at higher pressures, but progress in turbine design has greatly reduced this disadvantage. The reporter concludes that the small size and flexibility of high-pressure installations should give actual savings greater than those deduced by computation.

4.—*Resuperheating*—The reporter does not consider that resuperheating will be essential with higher pressures. Cutting of blades or nozzles by entrained moisture may be reduced by the use of stainless steels or other alloys. The gain in efficiency obtained by increase of pressure may offset that which might be secured by reheating. The reporter advocates the use of separate superheaters located near the turbine, so as to reduce the amount of metal exposed to the high temperatures, and does not consider temperatures of 1,000 deg. F unattainable.

Practical Developments in High-Pressure Steam Generation

The reporter shows that boiler duty could be greatly improved by increasing heat transfer through surface not directly exposed to radiation, by the use of finned boiler tubes presenting a large surface of contact with the furnace gases. Curves are given showing the heat transfer in successive layers of tubes in a boiler equipped with the ordinary type of tubes, and in one comprising finned tubes, the depth of the fins being increased as the temperature of the gases to which the tubes are exposed drops, so as to maintain the same rate of heat transfer per square foot.

These curves show that the amount of surface could be reduced by more than 50 per cent by this expedient. The boiler could be built single-pass, which would allow the use of higher gas velocities, resulting in more favorable convection conditions and greatly simplifying the problem of soot removal.

An experimental boiler designed according to this principle is under construction, and is expected to reach a vaporization rate of over 20 lb. per sq.ft.

*Abstract of paper presented at the Rome convention of the International Union of Producers and Distributors of Electrical Energy, Sept. 21 to Oct. 4, by E. Rauber, Superintendent of the Gennevilliers Station, Paris.

[1]A "reporter general" for each session was appointed to review the papers and open the discussion. For this session the "reporter general" was M. Herry.

Industry Must Support Pure Science

VERNON KELLOGG, secretary of the National Research Council, has just returned from Europe convinced from what he has seen there that America must play a more prominent part in pure-science research because Europe's contributions have materially fallen off.

As has been frequently pointed out in *Power*, a study of industrial history shows beyond a doubt that research is the cornerstone of material progress and that pure-science research is even more important than investigations in applied science, because it is more fundamental. Industry, it is true, has little direct contact with pure science. Engineering comes between, taking the discoveries of science and working them into practical machines and processes. If the supply of newly discovered facts is shut off at the source, engineering may continue for a while to furnish industry with new applications of old principles, but the great forward steps will cease.

Before the War Europe's laboratories produced most of the fundamental discoveries in pure science upon which American industries are built. But the War changed the situation. The financial pinch in most European countries has diverted to more immediate needs much of the support formerly given to the research laboratories. This simply means that the supply of our most important raw material, knowledge, has been curtailed.

America must carry on this work. A big start has already been made, but industry must find some way to give pure science far more substantial support than it has yet received.

New York State Has a Double Interest

DIVERSION of water from Lake Michigan through its sanitary canal into the Mississippi River, by the City of Chicago, has long been a much-discussed question. Although the United States Supreme Court early in 1925, ruled against the city for a greater diversion than 4,167 cubic feet per second, this intricate problem is not settled and will probably not be for some time, as a number of the states bordering on the Great Lakes have brought suit to limit Chicago's diversion from the Lakes. Recently, New York State added its objections to those of a number of others, by bringing suit in the Supreme Court. This action was taken after a ruling of the Court that permitted New York to join five other states in opposing the diversion. The present diversion is based on a temporary permit, granted by the late Secretary of War Weeks, shortly after the Supreme Court decision of last year.

Although the chief interest of the other states in this diversion is its effect upon navigation, New York, like the Province of Ontario, has a very large interest in water power that could be developed in the Niagara and St. Lawrence waterways. The ten thousand cubic feet per second that Chicago is seeking the right to divert from the Great Lakes could produce five hundred thousand horsepower in plants at Niagara Falls and along the St. Lawrence River. The value of this power at twenty dollars per horsepower-year is ten million dollars per year. This is not ten million dollars for one year, but each year for all time.

To these figures must be added the economic value of this power in a district that has no coal mines and, as in the case of the Province of Ontario, must import its fuel supply.

A Worth-While Conference

ECONOMIC conditions in Europe have long been responsible for a considerable lead over this country in the processing of coal. It appears, however, that we are now on the brink of witnessing marked commercial activity in this line on this side of the Atlantic, following several years of preliminary study and experimental installations.

To this end the international conference called by the Carnegie Institute of Technology for November 15 to 19, in Pittsburgh, is most timely. Its program as announced will include studies of the manufacture of substitutes for gasoline from coal, complete gasification of coal, high-temperature distillation, low-temperature distillation, coal-tar products, power, smokeless fuel and fertilizer. Thus it will hold interest for the chemist, the automotive engineer, the power engineer, the fuel expert and many others. The presence of such noted foreign investigators as Bergius and Fischer, of Germany, and Patart, of France, as well as a number of our own outstanding scientists, assures the character of the meeting. If it results in a free and frank discussion of the many factors involved, the cause of coal distillation should be materially advanced and many pitfalls avoided.

Already large quantities of methanol are being used in competition with wood alcohol, and judging from the present rate of gasoline consumption, coal byproduct substitutes will shortly come into wider use in the automotive field. There is also the broad problem of coal processing in connection with central-station power generation. This at present holds some uncertain engineering and commercial aspects concerning which opinion is divided. However, one central station has already set the lead, and it is reasonable to expect that others may follow as soon as the atmosphere has been cleared of a few doubts now existing in the minds of power engineers. A conference such as that scheduled for Pittsburgh next month should go far toward clearing up these points.

A Mine In One's Back Yard

A PROMINENT lecturer, recently deceased, won high reputation on the strength of an address entitled "Acres of Diamonds." Briefly, it discussed the wandering of a man seeking riches, who finally, disillusioned, returns home to find that the homestead is teeming with the hidden wealth of a diamond mine. The average engineer is in a somewhat similar situation. He is inclined to feel that if opportunity were given him in another and newer plant, wonders in savings could be shown.

On another page is a discussion of the results obtained in a small hospital plant through an inconsiderable expenditure in new equipment and through alteration in the existing apparatus. The saving shown is equivalent to interest on over a quarter million dollars, the cost of a two-thousand-kilowatt plant. In a modern plant of this latter capacity an engineer could not expect to show a reduction in operating costs of as much as twenty per cent, which, with the usual load conditions, would fairly approximate the saving made in the miniature hospital plant.

Small power plants almost invariably offer a greater opportunity for the operating engineer to obtain substantial cost reductions than do large stations. If engineers took advantage of every means of cutting the expense, the small plant would not be the expensive luxury that it is at present and there would be less abandonment of existing plants.

Combining Water Power and Steam Power

POWER systems have been developed in many sections of this country consisting of a number of interconnected steam and water-power stations. The economic relation between these two types of stations is based on factors that may vary through wide ranges. These factors are not only influenced by differences in geographical location, but they may be radically affected by changes in local conditions and improvements in plant design. It is on this account that many misunderstandings arise regarding the two classes of developments.

Between the two extremes of all water power and no steam and all steam and no water power may be found almost any combination of the two. Such conditions as are found in northern New York State and Canada warrant the use of little steam power. On the other hand, the power supply to large metropolitan cities is of such importance that they require a large steam reserve as an assurance against power interruptions, especially if the load carried by a water-power plant must be supplied over long transmission lines.

New York City is probably within practical transmission distance of the St. Lawrence River power. Even if this power could be delivered into the system at a lower cost than power from local steam plants, it would be a reckless undertaking to leave the metropolitan area dependent entirely upon a power source over three hundred miles away. On the Pacific Coast it has been established that steam reserve should be equal to about seventy-five per cent of the metropolitan peak where the water power is supplied over more than one transmission line. Water-power developments are far more favorably located with respect to the metropolitan districts on the Pacific Coast than the St. Lawrence River is to the New York City district.

Under any set of conditions the two sources of power will in all cases be in economic competition. The factors that control this balance may vary widely. As an example of this, radical improvements in steam-plant design, combined with large reductions in the cost of fuel, may put water power at a disadvantage, particularly if it has to be transmitted long distances and the transmission facilities are not already in existence. It should always be kept in mind that the cost of steam power is not a stable quantity on account of the changes in the price of fuel. On the other hand, the cost of power from a water-power development is fairly constant for any particular site, except as it may be affected by the amount of precipitation. Over a period of years the amount of rainfall in a given district can be depended upon to average up to a constant value, whereas the cost of fuel has a decided tendency to increase in value.

A common belief is that the base load should be supplied from water power and the peak loads from a steam plant. This combination, however, is affected by as many factors as the combined utilization of water power and steam. Whether the low-cost base-load power is supplied from a local steam plant and the high-cost peak power from a water-power plant and transmission line, or vice versa, there is probably little choice except as decided by local conditions. A water-power plant may or may not be able to supply peak loads, depending upon the amount of storage available, while the steam plant can be used under any conditions. The conditions affecting the use of water power and steam might be enlarged upon almost indefinitely, but those enumerated show that no definite rule can be laid down for their development, but effort should be made to obtain the most economical combination, and this may involve more than the production of power at the lowest cost.

Paternalism Is Sometimes Necessary

LITTLE sympathy is felt by *Power* for the paternal movement so apparent in governments, for the individual should possess all the prerogatives of a free agent, suffering the consequences of ill-judgment. Nevertheless, there are times and conditions when paternalism is essential, not to protect man from himself, but to insure others against the results of his folly.

A striking example of the terrible results of unrestrained individual freedom appears in the news pages of this week's issue, where the rupture of a Philadelphia unfired pressure vessel is noted. This plush steamer was built to carry steam at a very low pressure, but was so connected that full boiler pressure existed within, causing a rupture of a cast-iron door. Being unfired, the city boiler inspectors had no jurisdiction and those who had charge of the installing of the apparatus were either careless or ill-informed. From the evils of such half-baked engineering workmen have a right to be free. If laws had required the inspection of this steamer and the manner of installation, the two workmen would be alive today. The charged waste in industry extends too frequently to waste in human life.

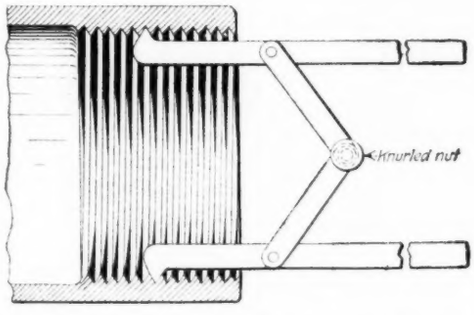
The Bureau of Standards has evolved a method of cleaning buildings by the use of steam jets. Here is an opportunity to utilize some of that steam which is wasted up the stack in the summer time.

Practical Ideas From Practical Men

Cleaning Tool for Internal Threads

Many devices for cleaning internal threads have been described, but most of them depend on the spring of the metal from which they are made to hold the cleaning points in contact with the work. The objectionable feature is that the vee points cannot be kept in alignment to fit various diameters, and consequently the threads are not properly cleaned.

A tool that I have made for scraping out the threads of pipe couplings, sleeves, nuts and other similar pieces is shown in the illustration. It is made from flat steel in four pieces, two vee arms and two links. The links are riveted to the arms a movable fit and are held together at the other end by a screw and knurled nut. In operation the nut is loosened and the arms opened or closed until the vees fit in the thread to be cleaned;



Cleaning points are parallel for all diameters

then, by gripping the arms in one hand, the vees are made to press against the threads as the work is revolved in the other.

H. MOORE.

Montreal, Quebec, Canada.

Changes Made to Boiler Settings To Improve Operating Conditions

About a year ago we made some changes to our boiler settings which greatly reduced the stack temperatures and increased the ratings at which the boilers could be operated. Before the changes were made, the stack temperatures would exceed 1,200 deg. and the damper plates and baffle supports in the last pass were being twisted and burned. As the stacks were only 50 ft. high, the maximum draft at the damper was around 0.40 in., and at normal ratings or slightly above there would be a considerable pressure above the fire. This condition caused the furnace arches to burn out frequently, and it was necessary to have a bricklayer on the job almost constantly to keep the boilers going.

As the furnaces were in bad condition, we decided to rebuild them completely and alter the design somewhat to improve the combustion. The original setting is shown in Fig. 1 and the revamped setting in Fig. 2. Referring to Fig. 3, it will be seen that three tubes on each side of the furnace were blanketed, owing to the furnace being made to accommodate the stoker width. In addition to widening the furnace as indicated by the

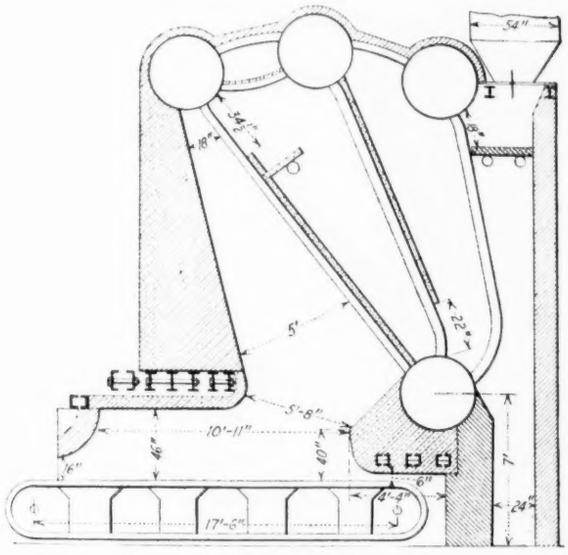


Fig. 1—Original boiler setting

dotted lines, a curtain wall of firebrick was placed within 18 in. of the first row of tubes, as shown in Fig. 2. The height of the arch above the stoker was

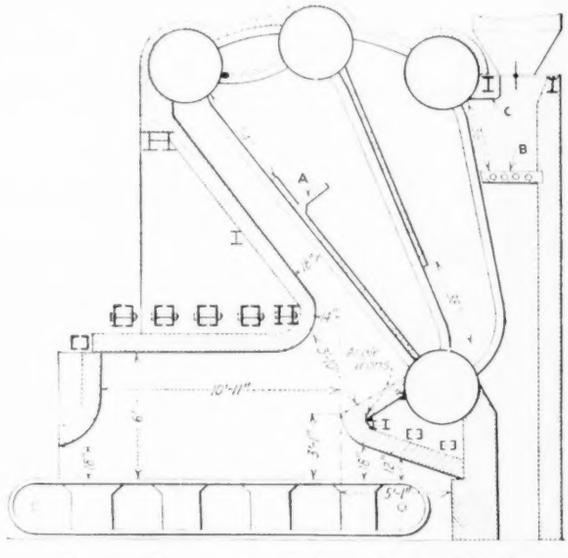


Fig. 2—Changes made in arches and baffles

increased from 46 to 72 in.; also, a hollow rear arch was installed, the top of which was supported by angle irons. At *A* in Fig. 2 is shown a special tile we made out of a mixture of three parts ground firebrick bats and one

part cement with wire to reinforce it. At *B*, 4-in. boiler tubes were carried through the side walls and incased in the refractory just mentioned. The same mixture was poured around the I-beam at *C*. All damper plates were reinforced with strips of light angle iron on each side. The height of the openings through the baffles was increased as indicated by the dimensions given, and this improved the draft considerably.

After these changes were made, tests were run, which showed that the boilers could develop ratings as high as 250 per cent with stack temperatures of 700 deg. At lower ratings the stack temperatures would run between 540 and 650 deg. While these temperatures are still a little high, they are undoubtedly due to scaled conditions of the water surface. Since these changes

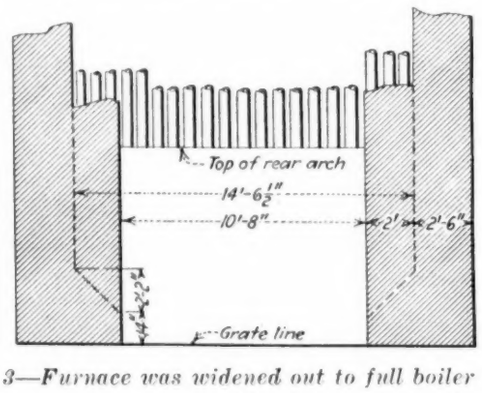


Fig. 3—Furnace was widened out to full boiler width

were made, the boilers have operated continuously for nine months without any furnace repairs or other troubles, carrying loads up to 250 per cent of normal rating. Upon inspection of the furnaces, recently, no signs of failure could be observed.

All these furnaces had a ½-in. refractory coating applied to them with a cement gun, using a mixture of three parts of ground burned firebrick bats, screened through a 22-mesh screen and one part of fireclay.

Scranton, Pa. ELLIOTT E. SMITH.

Should Coal Used in Putting a Boiler on the Line Be Included When Figuring Evaporation?

In a certain large plant it was customary to turn in the meter charts each morning from all boilers and to figure the evaporation from the coal scale tickets and the steam flow meter charts.

One morning the checker complained about the reports being all wrong. A cold boiler had been put on the line and showed an evaporation of only 7 lb., while another boiler that had been taken off the line showed an evaporation of 9.3 lb. The checker could not understand these differences and asked the boiler-room foreman why it took more coal to put a boiler into service than it did to take one out of service. Any fireman who has ever fired on a premium scale knows the answer.

The meter on the cold boiler gives no credit for the steam generated, until it is put on the line, yet the coal required to bring the boiler up to steam is recorded, while on the other hand a boiler on the line makes considerable steam after the coal feed is stopped owing to the accumulated heat in the boiler and setting and the fact that the automatic stop and check valve does not close until a difference on pressure of from 5 to 10 lb. exists.

Thus it can be readily seen that if any fireman can leave his relief less coal in the hopper than he got from his relief, he can make a favorable showing for evaporation if the load conditions are anywhere near constant. Care in coal weighing is also important.

Chicago, Ill. CARL WILDEY.

Length and Height of Boiler Arches

In the design of boiler arches the proper type, principle and location of stoking equipment must be considered. Arches are now used to advantage over chain-grate stokers, front-feed and side-feed stokers, and occasionally they are used over underfeed stokers.

What should be the arch length? Theoretically, the arch projection over the grate should be 100 per cent, but such a design is obviously impossible. Good practice calls for a 65 per cent projection with natural draft, which gives the maximum possible length while at the same time it provides sufficient exit from the furnace. Where the arch length is carried beyond this general limit, the easy flow of air through the fuel bed at the front is likely to be restricted, which condition would delay the proper ignition of the fuel. The longer the arch and the easier the flow of air through the fuel bed, the lower the carbon content of the ash and the less the smoke. With forced-draft stokers and ample furnace volume a long arch is not necessary.

There must be sufficient headroom. On natural draft a number of trials have shown that the most effective distances between the ignition arch and the fuel bed are from 7 to 9 in. and that there is no particular advantage in extending the length of this surface beyond 12 in. so far as benefiting combustion is concerned. There, are, however, many instances where mechanical difficulties have necessitated a departure from this practice. Under forced-draft conditions the larger volume of gases requires a greater space between the fuel bed and the ignition arch, it being approximately proportional to the amount of increased fuel burned per square foot per hour. The figures given apply to a coal rate of 40 lb. of free-burning coal per square foot per hour and an 8-in. fuel bed.

The height of the main or fire arch should be such that the intensity of heat reflection is sufficient to insure continuous combustion the full length of the grate and in addition provide sufficient volume for the intimate mixture and easy flow of the gases. It is thus evident that the height of the arch above the fuel bed is a function of the coal rate per square foot per hour. Under a normal natural draft and a coal rate of 40 lb. the most effective point is shown by experiment to be between 14 and 20 in. at the front end.

However, an arch constructed in accordance with this minimum requires that the pitch be such that increasing sectional area be proportional to the increasing flue-gas volume. This steep pitch does not permit of an intimate mixture of gases, particularly over the area of distillation, and unburned hydro-carbons and smoke are the result. These conditions are removed by raising the front end to the maximum height and using a pitch of about 1 in. per foot. With forced draft and a coal rate of 60 lb. excellent conditions were obtained with the main arch 4 ft. above the grate.

Newark, N. J. W. F. SCHAPHORST.

Comments from Readers

Making Insulation Resistance Tests

Mr. Whitson's article on insulation resistance tests in the June 8 issue of *Power* has been reviewed with considerable interest, and it is noted that twisted cord (probably ordinary lamp cord) is shown in the illustrations as being used for the leads between the object under test and the instrument used for testing. In this connection it has been our experience that erratic results may be anticipated when a twisted pair of leads is used between the object tested and the meter used in making the test.

At best, the readings obtained will be no higher than the insulation resistance of the cord itself, and in cases where such cord has been used for an appreciable length of time, with the resultant rolling up and pulling the cord over floors, machines, etc., its condition becomes questionable. It is our practice to use separate leads that are heavily insulated with tough rubber, and the results of the insulation-resistance readings that are taken have been much more consistent and reliable since discarding the twisted pair leads.

K. A. REED, Electrical Engineer,
Hartford Steam Boiler Inspection
Hartford, Conn. & Insurance Co.

Effect of the College on Engineering

Referring to the letter of A. C. Herren in the Aug. 24 issue on "Effect of the College on Engineering," it seems to me that he has the wrong opinion of the men who study engineering in colleges, or rather the method of instruction used in colleges. I have been fortunate enough to attend Lowell Institute, the night school conducted by the Massachusetts Institute of Technology, and thereby gained some insight into the method used.

There is no need for Mr. Herren to call the attention of the young college graduate to the fact that there is just as much need as ever before for the practical engineer. This is continually impressed upon the student from the day he enters college until he leaves. Students are drilled with the idea that they have got to look out for themselves, not to be handbook engineers—to learn how to use a formula and which is the right one to use and that the handbook is only for reference. It is impossible to know the problems that will confront the student after graduating, so all the theories and short-cut methods and danger of jumping at conclusions are taught so that the graduate may be not only practical but efficient.

One should not get the idea that a technical graduate never saw an engine or boiler until after he was out of college. Probably every college graduate has operated more different kinds of machinery than most non-college men twice their age. A professor once remarked to his class that "a college man was like a person standing on a high mountain. While it was possible that he did not know all there was to be known about every little valley in sight as well as the man living in it, he knew more about the country as a whole than the other fellow, and to go into every little valley to see what the whole country looked like would waste a lot of time."

It is true that a great amount of credit is due to the "old timers," or practical men, and at the same time a considerable amount of blame can be laid to them. While it is true that they had to dig it out for themselves, most of them, as the saying goes, kept it under their hats. Look back in history and see the old guilds with their closely guarded secrets. Then we have the journeymen going from place to place, thus broadening their views and later the college, where everybody could learn about it. When a college man meets a knotty problem, he will take it back to his old professor, who will help him with it and then pass it on to the undergraduate with the result that instead of only one man knowing the solution, hundreds of men know it. This, in my opinion, is the greatest benefit derived from attending college.

Concerning the lecture fetish I am inclined to think that its evils are over-rated. Obtaining one's education from lectures only would leave much to be desired, while on the other hand a lecture stimulates the mind and presents the matter from a different angle. A convincing speaker will arouse an interest in a subject that a textbook might dull. While a lecturer is likely to present his own views at some length, he will probably have later dope than the textbook and by listening to several lecturers the matter should be pretty well covered.

It probably is not so much the fault of the training that makes some college men fail to succeed after graduating as it is taking the wrong course. A youth has to decide upon what he would like to be, without, in most cases, ever working at that branch of engineering, or takes it to please a fond parent who is paying the bills, only to discover too late that he wants to do something else.

Sentiment plays a small part in business today. An executive wants results, and what is more natural than for him to hire men who know what the latest dope is and how to apply it to his own plant to reduce cost?

Now I will say a word to the "old timers" and every other engineer for that matter. Buy only the best textbooks on the branch of engineering at which you are working, read them carefully and then buy some more, and no executive will ever lay you on the shelf even if you are an "old timer."

Rockland, Mass. BURTON W. WHEELER.

Painting Pipe Lines

In the Aug. 17 issue Raymond L. Drew questions the utility of the elaborate system of painted pipe lines frequently proposed as means of identification. He wonders if these systems have much practical value.

I have also wondered. It occurs to me that in a plant containing high and low-pressure steam lines, high and low-pressure water lines (sometimes with water from various sources), high-pressure air lines, vacuum lines.

ammonia lines both liquid and gaseous, and other lines carrying both materials and products of manufacture, a system of colored piping is likely to cause confusion. The fact that a man may know the significance of the various colors while he is in a mental calm is no assurance that he will in an emergency. I have too often seen the result of failure to apply common knowledge in an emergency.

Should I find the immediate identification of pipe lines a necessity, I would stencil them with the names of the pipe contents spelled in full or with the conventional abbreviations, and with an arrow indicating the direction of flow. These markings would be placed in all advantageous positions. C. O. SANDSTROM.

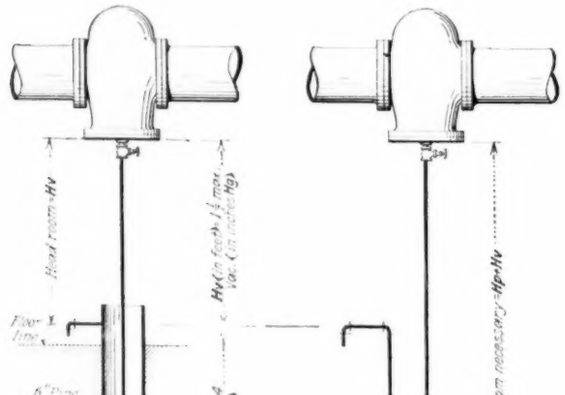
Los Angeles, Calif.

Connecting Trap to Exhaust Lines for Pressures Above and Below Atmosphere

In the Aug. 17 issue, Julius Brodsky shows methods of connecting traps to exhaust lines for pressures above and below atmosphere, but it seems to me that some of the arrangements which are reproduced herewith could be simplified and improved.

I would say that only one trap is required in Fig. 4, and that it is doubtful if the so-called low-pressure trap would operate satisfactorily when receiving the discharge of the tilting trap. Furthermore, why vent this trap to the vacuum trap, or to any place for that matter? The arrangement shown in Fig. 3 is correct if the water seal is omitted. Incidentally, neither of these arrangements obviates the necessity for headroom, as a distance of 6 ft. is preferable from trap to separator, though it may be cut to 2 ft. if necessary.

In Fig. 2 it is necessary that the pipe on the discharge side, or left-hand leg, of the seal be large enough to supply the head required on the opposite side of the seal whenever a change to vacuum takes place. Furthermore, if the seal is connected up in such a way that one side forms the long leg of a syphon, it should be vented to atmosphere at its crest, or else the portions of the pipe forming the crest and the long leg must both be made so large that siphoning would not occur, the liquid never filling the full bore of the pipe at this point. It is also well to provide for cleaning out the seal by means of a valved drain or brass plug at the bottom of the pipe loop. As for the distance given of 2.4 times the back pressure, this will be nearer 2.7 if the weight of mixed oil and condensate is taken into account. The reason for the addition of 3 to 5 ft. is not clear.



Figs. 1 and 2—Types of water-sealed U-columns used as traps

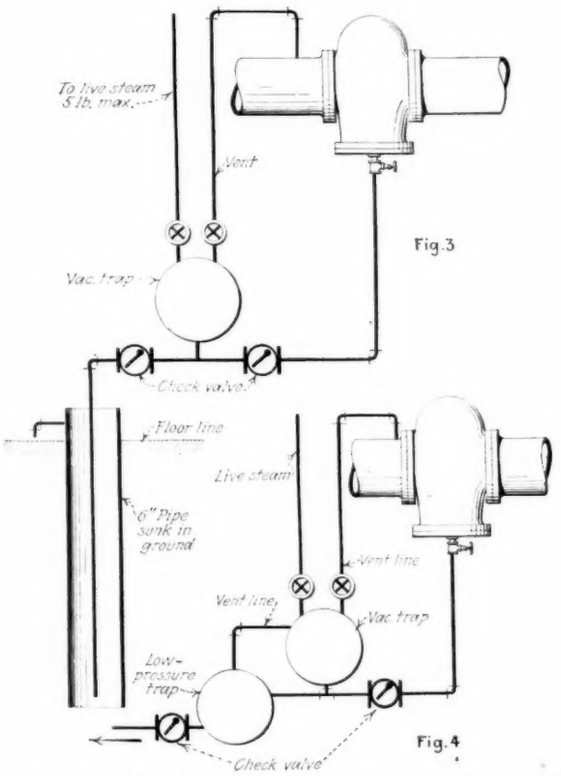


Fig. 3—Combination of vacuum trap and water-sealed U-column. Fig. 4—Combination of vacuum and low-pressure trap

Highlands, N. J. T. W. REYNOLDS.

Probity—An Ethical Condition

When we read the "Forewords" in *Power* we are many times forced to think and thereby profit. "Webster's" is called into action, and other references we may have at hand are well thumbed. Our education is thereby enhanced. We are taken, as it were, from the realms of the power plant for the nonce and guided in mind to problems apart. Then again, are they apart?

To quote Webster, "Probity denotes unimpeachable honesty and virtue, shown especially by the performance of those obligations, called imperfect, which the laws of the state do not reach and cannot enforce." The word is synonymous with integrity, which denotes a wholehearted honesty, and especially that which excludes all injustice that might favor one's self. It has a peculiar reference to uprightness in mutual dealings, transfer of property and the execution of trusts for others.

But why put such a problem up to a race of human beings who for centuries have been getting so lop-sided of mind? Is it fair to assume that the human brain, having brought us to the present state of perfection

in the arts and sciences, is capable also of developing the spiritual side? Has not the world, so called, advanced through conquest and aggrandizement? What has been the dominating thought? It certainly has not been Utopian.

There are men and their numbers are not legion, who, when at their mother's knees learned their prayers and the Ten Commandments and later in school learned the Golden Rule. They are today advocates of the same thought brought out in the Foreword, "Probity to Order," in the Aug. 17 issue, but in their intercourse with the world find, much to their dismay, that they are outnumbered many times by men whose whole creed tends toward selfishness. Look that up in Webster's.

The problem propounded by the last line of the Foreword, "What can we do to cultivate it?" will never be solved until the hearts and the minds of men are turned back thousands of years to what Christ died on the Cross for.

W. FREDERICK.

Springfield, Mass.

"Writing Yourself to the Fore"—In Europe

The number of letters I have read in *Power* on "Writing Yourself to the Fore" prompts me to tell a few of my personal experiences in "writing myself to the fore" in Europe. My experience in this line has been from the other side of the fence from that of most of *Power's* contributors. In other words, I was out of a job when I began to write, and did so for the specific purpose of advertising my wares and getting someone sufficiently interested in me to take me on. Getting an engineering job in Europe is much more difficult than in the United States, and the pay is usually less than half—so cheer up, American engineers!

Anyone who wishes to write himself to the fore over here has a real job ahead of him. He must first collect the material. As A. H. Myers remarks in a letter in the July 27 issue, European manufacturers are closer in respect of giving out information than American manufacturers usually are. On general principles technical articles are not paid for by magazines, and the reverse is sometimes the practice. Many magazine articles are paid for by the manufacturer, and of course they are printed just as they leave the manufacturer's hands. I remember the case of a magazine of considerable standing, that published a description of a new central station. I had occasion to get inside the editorial office during the preparation of this article. Each manufacturer of the more important equipment of the station had sent in a description of his material. These were printed without change. I was able to secure five or six of these descriptions and checked them against the published article after it appeared in print. Not a comma had been changed. The result was rather ludicrous.

Now bear in mind this custom, and you will understand the troubles encountered by an independent writer who is primarily interested in advertising himself. He is pinched between the manufacturer, who wants the stuff published his way, and the magazine, which would like to get paid for everything it publishes. The manufacturer gives him the article as he wishes to see it in print. Then he must analyze it carefully, and comb the experimental data and test results through with care. Then comes the worst job of all—to get from the manufacturer the additional information necessary to patch up the original story. Finally, after he has written the article as he sees it, he must get the manufacturer's approval, which is not usually easy.

I once got in touch with an oil-engine manufacturer who was doing considerable talking about a new type of engine which he claimed was lighter, higher speed, more efficient, better to look at, etc., than anything ever produced before. I wanted to prepare a description of it and asked for test results, characteristics, etc., and a personal demonstration. He was most agreeable and the personal demonstration was granted after some hesitation. Unfortunately, on the date set for this event the engine was "being slightly modified." But another engine "just like it" was run in its place. In reality, the second engine was of an old type, with none of the innovations of the new engine. It ran, of course, very well, and I congratulated the builder and asked when I might see the other engine under test. This seemed to grieve him somewhat. I am still waiting for this demonstration, and have since learned that the new engine has not yet turned over, and that the articles published by the technical press gave photographs and drawings of the new engine with test results secured with the old.

Other manufacturers are unbelievably "close." One concern has acquired patent rights on a new internal-combustion engine of considerable interest. I obtained a personal demonstration and was much impressed with the qualities of the engine. The innovations are covered by iron-clad basic patents that afford practically perfect protection. But the manufacturer's answer, when I asked for material for an article, was: "Not yet. When I have 1,000 engines in practical service, I'll give you all you want."

Different nationalities present entirely different kinds of material, each requiring special treatment to reduce it to a common plane. The French give you a clear, logical statement, with rational, clear-cut conclusions—a perfect story for publication, with certificates and guarantees signed by well-known authorities whose integrity is beyond discussion. But when you ask for test or operating results to back the statements, they are usually incomplete. The Italians meet you with a mass of mathematics. The Germans swamp you with microscopic test data and observations, from which nothing stands out and no clear conclusions are drawn. You can, however, nearly always find in their material ample data upon which to base your own opinion and conclusions. But it means a great deal of work.

On the whole, "writing yourself to the fore" in Europe is a thankless job, but it is quite valuable from the educational viewpoint.

STANISLAS BOLITZ.

Dresden, Germany.

Where Is the Longest High-Pressure Steam Line?

We should like to obtain information, if possible, regarding the longest high-pressure steam line now being used in the United States. So far as we know, a steam line installed by us at Bird & Sons, East Walpole, Mass., is the longest one in New England. This is an 8-in. 200-lb. steam line, one mile long.

Any information regarding this matter, would be greatly appreciated.

HILDING N. CARLSON, Manager,
Cambridge, Mass. R. H. Baker Co., Inc.

Return Trap for Boiler Feeding

Much valuable information on return-trap operation is contained in the article by J. H. Whitaker in the Sept. 7 issue, but the points he raises are entirely outside the title of the article and do not prove that the trap method of boiler feeding is more economical than the pump method. He cites a case where the driers are supplied with exhaust steam at 228 deg. (5 lb. gage) and a return trap discharges the condensate to the boiler at 225 deg. This is possible, but as previously pointed out, live steam is condensed to maintain this temperature.

I installed a return-trap system at one time which apparently increased the evaporation per pound of coal, as the water was fed at higher temperature than with the feed pump. But the coal consumption remained the same, so there was no real saving, as 2,000 lb. of additional live steam was used in the operation of the traps, and it is evident to anyone that high-feed temperature by live-steam heating does not improve plant efficiency. We are told that in another plant a return trap took water from an open heater at 205 deg. and discharged it at 240 deg., an apparent gain if we ignore thermodynamics.

The advantage of the efficient drainage of steam-using apparatus by trap system is not disputed, and while production is increased by improving the drainage by the addition of traps, it does not follow that the use of traps should be extended to boiler feeding. At one plant the boiler load was 20,000 lb. an hour and the coal burned, about 2,000 lb., giving an evaporation of 10 lb. A trap installation raised the feed temperature from 212 to 259 deg., and the evaporation jumped to about 10.5 lb., but the boiler load jumped at the same time to 21,000 lb., leaving the coal consumption unchanged. Would it not have been better for the plant if the engineer had delved into the theory of thermodynamics and steam-trap operation before installing the traps?

Brightwood, Mass. A. F. SHEEHAN.

Operation of Air Preheaters

After rereading an article on air preheaters in an old issue of *Power*, I am prompted to tell the story of air heating in our plant.

The heaters are of the rotative type with the induced- and forced-draft fans on one shaft and driven by a turbine mounted on the casing. They are connected to the breechings of three 8,000-sq.ft. horizontal water-tube boilers. The air duct is of steel plate and runs vertically downward, then horizontally under the basement floor to a position directly under the stoker, which is an eight-retort underfeed.

The author of the article makes some observations on fouling of the elements or plates and the probability that some fuels would give more trouble than others. We had trouble with fouling, but I think it was not due so much to the fuel as to the fact that we were getting a lot of water in our steam supply to the soot blowers. The fouling did not take place between the plates, but on the top and bottom of the rotor. It looked as if the soot had mixed with the water and baked on. We scraped it off and washed the rotor and, at the same time, covered the steam supply line to the soot blowers and have not had any further trouble from fouling.

Another trouble that we encountered was lack of induced draft at high ratings, owing to the two fans being on the same shaft. This was overcome by adjusting the blade angle on the induced-draft fan to give sufficient draft on all ratings and then set the furnace damper regulator to take care of the draft over the fire. Of course, in cases where there are no regulators it would be necessary to adjust the draft by hand.

When we have had trouble at high ratings with slagging and subsequent erosion, we have found the fuel to be largely responsible. A change of fuel has enabled us to carry the higher ratings with decidedly less damage to the refractories, but we still find refractory upkeep at high ratings to be a serious consideration. Nevertheless, the resulting reduction of combustible in the ash clearly demonstrates the value of preheated air.

Kenora, Ont., Canada. E. G. RENOLDS.

Modernized Boiler Plant and Electric Drive Nets 35 per Cent on Investment

After reading the interesting article by H. M. Wilson in the September 21 issue entitled "Modernized Boiler Plant and Electric Drive Nets 35 per Cent on Investment," one feels inclined to raise the question as to why some of the engine-driven generators were not retained to produce sufficient power to provide for the exhaust-steam requirements of the mill.

The article states that the mill was originally operated by means of steam engines totaling more than 1,200 hp., about one-third of this being in the form of direct-current engine-driven units.

It would, apparently, have been possible to have retained the direct-current sets and to have operated them in parallel with the motor-generator set so as to produce just enough exhaust steam for the dyehouse, heating system, etc. It is, of course, possible that some other factors entered into the case which made such a course inadvisable, but no explanation is given as to why this was not done, and the point is one likely to be raised by many readers.

In localities where comparatively cheap central-station power is available, the use of engine-driven units in conjunction with purchased power in most cases gives an economical arrangement.

In many plants the demand for exhaust steam even in the winter is frequently less than would absorb all the exhaust from engines carrying the full load, and by shifting enough of the load to the outside power circuit an almost ideal arrangement is obtained, as a balance can then be readily obtained so that no steam will be wasted to the atmosphere at any time.

When power is purchased on a peak-load basis, it is also possible to reduce the peak considerably with such an arrangement and thus to make a material reduction in the power bills. Where the peaks are of comparatively short duration, it is usually economical to waste considerable exhaust to the atmosphere during such periods. D. F. GRAHAME.

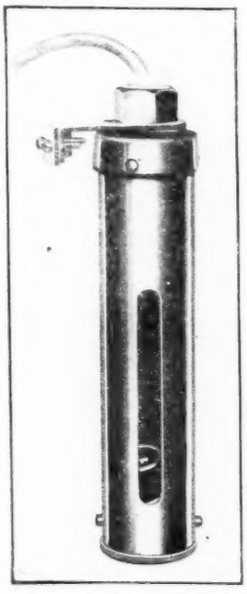
Montreal, Canada.

IN THINKING OF CENTRIFUGAL COMPRESSORS, it is necessary to keep in mind the substance being pumped. If this substance is practically incompressible, such as water, it is possible to obtain high delivery pressures without operating at excessive speeds. However, when the substance is readily compressible, such as air, present designs care for low delivery pressures only with operation at normal speeds.

New and Improved Equipment

Boiler Gage Light

The illustration shows a boiler-gage light, consisting of a tubular reflector with a bayonet attachment to the socket flange, brought out by the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa. A compression spring serves to maintain the connection and to hold the lamp in place, so that neither the reflector nor the lamp can loosen under vibration.



Gage light designed to resist vibration

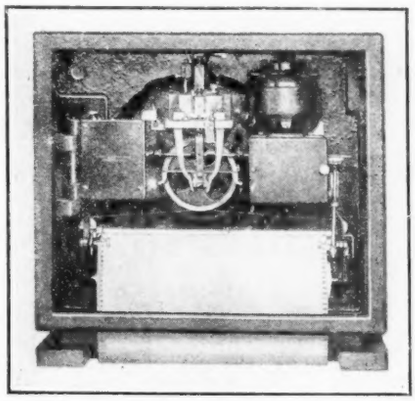
The design of the light permits mounting on the guard rail of any boiler water gage or on the end of a ½-in. conduit used to carry the wiring to the light. The reflector is readily removed by turning it slightly with the hand, which disengages the bayonet attachment.

The reflector is made of heavy brass tubing with a slot in one side to throw the light on the water gage only. It is easily adjustable for any desirable mounting height, and the mounting brackets are arranged to accommodate a wide range of positioning of the guard rods with relation to the gage.

Recorder for Measuring Field Winding Temperatures

For quite a number of years it has been general practice to measure the stator-winding temperatures of large alternating-current generators when they are in operation. This was comparatively easy, as this part of the machine is stationary and temperature coils could be built into the slots with the windings and brought out to suitable terminals. Measuring the temperature of the rotor has offered a somewhat more difficult problem, since the windings are on a revolving member and connection to them must therefore be made through a sliding contact.

Recently, the Leeds & Northrup Co. has placed on the market a recorder, shown in the figure, for measuring the rotor temperature of alternating-current generators. This instrument provides a means of obtaining a continuous record of the temperature of the revolving field winding while the machine is in operation. The temperature measurement is based on the change in resistance of the field winding. For the recorder the company's standard equipment is used and the electric measuring circuit is a Kelvin double-bridge arrangement, so that while the main field current is used for obtaining the



Field-winding temperature recorder

temperature, the measurements are independent of the value of this current. In cases where the field-circuit brush and brush-contact resistance would cause appreciable error, auxiliary brushes may be mounted on, but insulated from, the main brush supports, and make contact with the slip rings, to provide potential points for the temperature measuring circuits.

Moisture Indicator

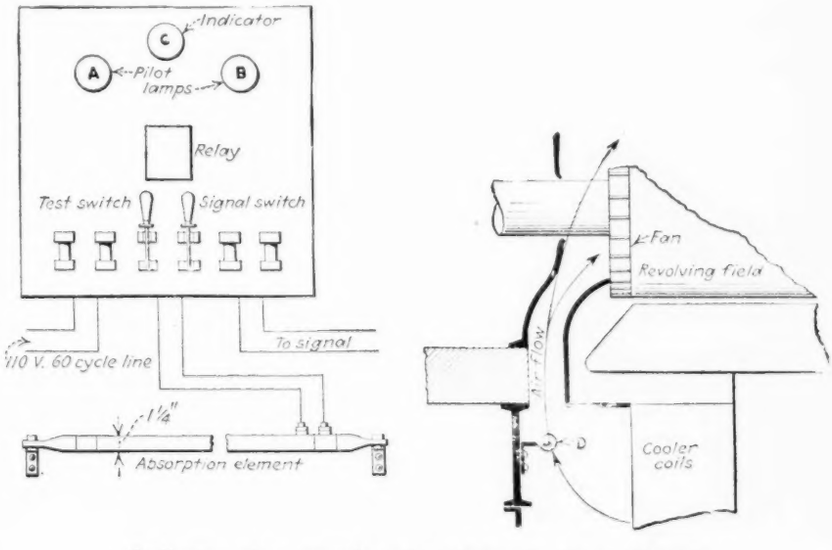
The illustration shows a device designed to protect generators and similar apparatus from damage through moisture in the cooling air by giving warning before the dangerous saturation point of the air is reached.

Referring to the illustration, an absorption element *D* is located in the air duct or other point where it is desired to detect moisture and is connected electrically with suitable indicator and signals grouped on a small panel. The element is connected in series with a relay across a 110-volt alternating-current line with suitable connection through the relay circuit to the signal lamp and horn.

In operation, so long as there is no moisture present in the air flowing past the element, the two white lamps *A* and *B* on the panel are lighted and the red lamp *C* is out. But as soon as the air flowing across the absorption element passes the dew point and moisture is either being precipitated or is being carried in the blast of air, the relay trips, extinguishing the white lamps and energizing the horn or other signal. The red lamp *C* simultaneously lights up in proportion to the voltage across the relay coil, the brilliancy of the lamp being an indication of the amount of moisture present.

The elements, which can be furnished in any length up to 10 ft., may be placed in any position and several may be connected in parallel.

The indicator is applicable to air washers and air conditioning apparatus as well as generator air coolers. It is manufactured and distributed by the Moisture Indicator Co., 1200 Main St., Worcester, Mass.



Indicator gives warning of moisture in the cooling air

Experts Give Instructions for

Maintaining Storage Batteries

IN STORAGE BATTERIES the most common causes of plate trouble are short-circuits, abnormal sulphation and impurities in the electrolyte. Short-circuits may result from the positive and negative plates coming in contact by buckling; by the displacement of the small hanging lugs or from particles of lead or other metals lodging between them; from spongy growth or from scale on top of the plates bridging over between them; and from sediment in the bottom of the tanks accumulating sufficiently to touch both positive and negative plates.

If a short-circuit is caused by buckling or breakage of plates, the trouble should be remedied by the replacing of the separator or possibly by inserting a strip of thin wood at the point of short-circuit in addition to the old separator. When the plate is in such condition that the trouble cannot be permanently overcome, it will be necessary for the plates to be replaced. Straightening of plates has been tried at various times, but the operation has been found to be rather unsatisfactory.

Small pieces of metal may occasionally fall into a cell and by lodging between the plates cause a short circuit; this may happen particularly at the time when the plates are burned in, either during installation or when subsequent repairs are made. For this reason careful inspection should follow the work.

After a battery has been in service for some time, there may appear a deposit of spongy lead on the top of the negative plates due to excessive charging or a deposit of scale on the positive plates. This deposit should be removed before a sufficient quantity accumulates to bridge across the plates.

Loss of Active Material

In proportion to the amount of work done by the battery, the positive plates lose their active material, which falls to the bottom of the tank as sediment. Tanks are built with space under the plates sufficiently deep to receive all the sediment that will be deposited during the complete life of one set of positive plates. In stand-by batteries a 6-in. sediment space is considered sufficient. In worked batteries, with old style tanks that have shallow sediment space, it is necessary to keep informed as to the depth of sediment accumulating and to remove it before it touches the bottoms and short-circuits the plates.

The presence of a short-circuit in a cell is indicated by its behavior as compared with other cells. Its specific gravity will fall off, its voltage will drop below normal, there will be some rise in temperature, and the cell will be slow in gassing or will not gas at all on charge.

A simple method used for detecting short-circuits in a cell is to measure the voltage drop across the connecting lug of the negative plates with a millivoltmeter. A cell having an internal short-circuit will give a slight indication across the lugs of the plates which are not in trouble and a very much greater indication across the lug of the plate in trouble. When the negative plate that is short-circuited is determined, the two positive plates adjacent to it are tested for the exact location of the short-circuit. The separator is then pulled, the short-circuit cleared and the old separator, or a new one if necessary, installed.

This reduces the amount of labor in the clearing of short-circuits. With a close inspection of specific gravity, individual cell voltage and temperature indications and the use of the above method of clearing the trouble, it is possible to maintain the cells without a large loss in capacity, oftentimes eliminating a separate cell charge. A millivoltmeter with a low scale is satisfactory for this purpose. When measuring the lug drop, the first contact must be made at a point somewhat above the electrolyte level and the other contact then made at the top of the lug. With the reverse order of making contacts there is danger of damaging the meter, from the lower prod touching the electrolyte.

Cells that have been short-circuited should receive a separate charge sufficient to restore them to normal condition, after the cause of the trouble has been removed. The active material is partly sulphated, which is a normal condition, but when a cell does not receive sufficient charge to reduce all the sulphate formed during discharge, or by local action, there is a gradual increase in the amount of sulphate until it takes a hard crystalline form unmixed with active material. This condition is termed abnormal sulphate. Hard sulphate is a poor conductor of current, and when abnormal sulphating has occurred, a charge extending over a long period at a low rate is required to reduce the sulphated material to normal condition. Conditions of operation that produce abnormal sulphate are: Standing discharged for a long period; habitual undercharging; the unnecessary addition of electrolyte instead of water to replace evaporation; and neglect of short-circuited cells.

Certain foreign materials that may enter the electrolyte increase the action upon the plates considerably beyond normal, reducing both the capacity and the life of the plates.

Effects of Iron in a Cell

Iron in a cell discharges both positive and negative plates, through being deposited on them and creating local action. If present in sufficient quantity, it seriously attacks the positive plates and materially shortens their life. Its presence may be detected by a light yellow coloring of the positive plates and a strong odor.

Copper deposits itself upon the negative plates and forms local elements which discharge the plates. Its presence is indicated by ebullition of gas at the negative plates when the cell is not charging, and by a copper coating on the lugs.

The effect produced by chlorides or nitrates is an increased formation of the positive plates, shortening their life and in some cases resulting in their buckling.

It is detrimental to the plates if fumes of muriatic acid or ammonia are allowed to enter the battery room and remain there any length of time. Batteries located near chemical works are especially exposed to this danger.

Low Capacity of a Cell

The failure of a cell to give capacity may be due to the natural wearing out of either the positive or the negative plates or to any of the causes mentioned in the preceding paragraphs.

The plates will give rated capacity as long as they have sufficient active material in good condition, with proper state of porosity and contact. The natural wear of positive plates consists in the gradual loss of active material; that of the negative plates, in the loss of contact and porosity by reason of shrinkage of the active material.

Under some conditions it may be expedient to make partial plate renewals. Plates of like polarity of different age or design should not be installed in the same cell. The positives and negatives, however, may be of different ages.

There is a gradual lowering of the specific gravity of the electrolyte due to minute quantities of acid being carried

A STORAGE BATTERY unless given careful attention, may get into bad state of repair without giving any alarming indications of what is happening. If such conditions are allowed to develop, it may be difficult or impossible to restore the battery to normal. Attention to a few simple details, as given in this article, will not only prevent trouble but very materially lengthen the life of the battery. These instructions are from the "Manual of Storage Battery Practice" of the Association of Edison Illuminating Companies, presented at the Associations 42nd Annual Meeting in Quebec City, Sept. 27 to Oct. 1, 1926.

off with the gassing spray on each charge, and to the sediment that accumulates in the bottom of the tanks absorbing some of the acid. These losses must be made up, but only at long intervals or when the gravity, with the battery fully charged, has fallen 30 points (0.030 sp.gr.) below normal. To raise the gravity, add new electrolyte of normal strength when replacing evaporation, repeating until the gravity of the cells is restored to normal, after which water should again be used for replacing evaporation. Acid of a density higher than 1.300 specific gravity should never be added to the cells, as electrolyte of the higher densities has been found to be detrimental to the plates. In purchasing acid, however, a saving can be effected by procuring acid up to 1.600 specific gravity, which may be reduced by mixing with water and which is safe to handle in the mixing process.

Testing Acid and Water

Since certain impurities in the electrolyte are detrimental to the plates, special care must always be taken that both the acid and water used in the battery are suitably pure. Local water may or may not meet the requirements. The suitability of either acid or water always should be passed upon by the battery manufacturers who will analyze samples free of charge; this applies also to electrolyte in cells in which impurities are suspected. Not less than eight ounces of electrolyte or one quart of water is required for this purpose.

If harmful impurities are present in a cell, the safest procedure is immediately to remove the electrolyte, flush the cell thoroughly with water and refill with fresh electrolyte. This new electrolyte should be of the same specific gravity as that drawn from the cell and adjusted if necessary to normal gravity after the cell has been given a proper charge.

The subject of battery maintenance concerns the life of the tanks as well as that of the plates. This is especially true of batteries in stand-by operation where long life of plates may be expected. Plates that are considerably aged may not bear handling, although if not disturbed they would last for a much longer time. Therefore, if for no other reason, tank renewals and repairs should be kept at a minimum.

Care of Wooden Tanks

To obtain the greatest life of wood tanks, it is important that the battery room be kept as dry as possible by proper ventilation and care, and that the battery be equipped with cell covers. Overflowing cells when adding water should be avoided.

The tanks should be painted with a good grade of asphaltum paint at the time of installation, and should be repainted whenever the coating shows signs of deterioration. An occasional light oiling of tanks with raw linseed oil is also a preservative. If the wood checks from shrinkage, the openings should be filled with thick paint or with compound. In old tanks the woodwork is likely to open up at the dovetailing and, if taken in time, may be repaired by bracing with insulators or by banding.

Leaks in tanks are caused by punctured linings, seam holes and electrolysis. Punctures arise from accidents or carelessness in handling. Electrolysis is caused by electric leakage from the cell to ground, as a result of the insulators becoming coated with a film of acid or dirt, or being broken. Electrolysis is more likely to occur on the positive side of a three-wire system battery with a grounded neutral as the lead linings of these cells are positive to ground. These troubles are not common in present-day practice where oil insulation is used. Seam holes are due to improper lead burning.

Minor leaks can usually be repaired by a lead patch, but frequently electrolysis may have advanced so far before being discovered that it may be necessary to put in a whole new bottom lining, extending several inches up the sides of the tank. The wood of the tanks becomes more or less soaked with the acid that has leaked through the lining and before relining, the acid should be neutralized with air-slaked lime and the wood dried and painted. The insulators should be kept free from dirt and acid film. Cracked or broken insulators should be replaced with new ones.

It is recommended that air-slaked lime be used on the floors to offset any acid spray or drip from the cells. Air-slaked lime absorbs the moisture and neutralizes the acid. A thin layer spread on the floor under the tanks and about two inches into the aisle from the tank, will be found to be satisfactory. This process keeps the floor dry at all times.

Care of Copper Work

The care of the copper work in battery rooms is mainly a matter of cleaning and preventing any collected corrosion from falling into the cells. It should be painted with white lead or coated with heavy oil or grease as a protection against the acid spray. The use of heavy oil or grease, while being satisfactory as a protection against corrosion, has the disadvantage of being unsightly and of collecting dirt and dust. The copper supporting structure should be protected against acid fumes by applying acid resisting paint. The practice of applying acid-proof compounds on horizontal metal parts of the battery has been found to be satisfactory.

The active material from the positive plates when worked, is gradually thrown off and settles to the bottom of the tanks. A space underneath the plates is therefore provided for the accumulation of this sediment. Present-day stand-by usage of batteries calls for little or no sediment removal. In most cases the sediment is removed at the time of the renewal of plates, when it can be shoveled or bucketed out. If, for any reason, sediment removal becomes necessary during the life of the plates, either the scoop or the pump method should be used.

In the scoop method a sufficient number of plates from the end and middle of each tank are cut out if necessary to make room for the introduction of the scoops. The sediment is drawn to the end of the tanks and then removed with a scoop suitable for the purpose.

There are two ways of utilizing the pump method, one by circulating water through the tanks and the other by circulating acid, the latter having the advantage in the respect that the battery does not need to be open-circuited at any time during the cleaning.

In the first case the acid is removed from the tanks and water run into them at sufficient pressure to stir up the sediment, which is pumped into settling tanks. Plates must not be allowed to dry during the work.

In the acid method the overflow from the settling tanks is pumped back into the cell being cleaned, at a speed sufficient to stir up the sediment. The pumping out of the sediment and the returning of the acid from the settling tanks is done at approximately the same rate of speed, so that the plates remain immersed in the electrolyte during the operation. Bronze composition centrifugal pumps should be used for this kind of work.

Where it is possible to have considerable difference of level between the cells to be cleaned and the settling tanks, one of the operations of the cleaning may be done by siphoning the liquid from one to the other, provided the difference of level is enough to give sufficient force to stir up or draw out the sediment.

Vibrations a Nuisance

By A. L. H. Street

Merely because one cannot reasonably expect to hear birds sing or sniff the odors of flowers in an industrial district, it does not follow that the operator of a power plant is licensed to choke his neighbors with smoke or deafen them with noise, in effect holds the New Jersey Court of Chancery in the case of Wallace & Tiernan Co. vs. United States Cutlery Co., 128 Atlantic Reporter, 872.

The court ruled that it constituted a nuisance abatable by injunction for defendant to operate a high-speed engine and generator, ceaseless pounding of which caused plaintiff's near-by factory to vibrate.

The opinion indicates that the rule that an industrial plant may not be a nuisance in a factory district, although it would be in a residential or commercial district, is not to be extended to give unrestrained license to plants in industrial districts. It is observed that "The right of enjoyment is surrendered in a factory district only to the extent of the inconvenience incident to the character of the business carried on there, no more."

The "Volkhovstroy" Power Station

The electrical power station "Volkhovstroy" erected on the river Volkhov, which is to supply electrical power to Leningrad, will be set in operation in the course of November, 1926, at a capacity of 20,000 kw. It is expected that the station will be completely equipped by July, 1927, when it will be operated at a capacity of 56,000 kw.—*Russian Review.*

News in the Field of Power

Accident Halts 77,000-Kw. Unit at Crawford Ave.

The labyrinth shaft packing on the high-pressure end of the low-pressure section of Unit No. 4 in the Crawford Avenue station of the Commonwealth Edison Co., Chicago, failed at about 6:30 a.m. on Oct. 14, and forced a shutdown of the unit.

One ring of the packing failed in a manner and from a cause unknown, and broke up within the packing casing. Pieces of this ring worked out between the packing casing and the shaft hub, and spun the end of the casing bell-shaped, increasing the clearance to 1½ or 2 in. It is apparent that the packing casing had been red hot, and there is evidence of burned metal at some points. The increased clearance allowed portions of the broken ring to pass through the nozzles and buckets. The first-stage buckets were bent and rubbed, and the buckets of the second, third and fourth stages show occasional dents. The wheels seem true.

Immediate repairs will consist in replacing the packing and reshaping the buckets in place. A new set of first-stage buckets has been ordered, and the wheel will be rebucketed when the machine is next opened.

It will be recalled that this new machine, the last to be installed, is a cross-compound two-cylinder single-flow unit with impulse blading throughout. The high-pressure turbine drives a 28,250-kw. generator at 1,800 r.p.m. and the low-pressure turbine a 46,750-kw. alternator at 1,200 r.p.m. The high-pressure machine has fourteen stages. Steam enters at 550 lb. gage and exhausts to the low-pressure turbine at a pressure of 67 lb. gage at full load, passing through the ten stages in the low-pressure end to two vertical condensers.

For two months the machine had been in regular and satisfactory operation with no indication of trouble. After an overnight shutdown the unit had been started about 1½ hours prior to the accident.

Depending upon the arrival of new packing, it is probable that the unit will be back in service in the course of a few days.

Power Show Reveals Heating and Ventilating Progress

Heating and ventilating apparatus will form one of the important sections of the Fifth National Exposition of Power and Mechanical Engineering to be held at the Grand Central Palace, New York City, Dec. 6-11.

Over 148 exhibits of all types of equipment for heating and ventilating will present the novel developments that modern industry demands for its present program of increasing the productivity and economy of its factories. These lines of engineering are making great progress under the stimulus of the demand for greater knowledge of their processes.

Under the leadership of the American Society of Heating and Ventilating Engineers substantial gains have been made in new information that will simplify the problems of design and selection of heating and ventilating equipment. President W. H. Driscoll of the A.S.H. and V.E., and Homer Addams, a past-president are members of the Advisory Board for the Power Show.

Plush Steamer Ruptures—Killing Two Men

Two men were killed and one seriously injured by the rupture of a steaming tank at the plant of the La France Textile Manufacturing Co. in Philadelphia on Oct. 10.

This tank was built of ¾-in. steel plate and was 8 ft. long by 7 ft. 5 in. in diameter. The vessel was designed for a maximum pressure of 10 lb. and was to be used to steam plush at about 2-lb. pressure, and at one end the head was provided with an opening 47 in. by 64 in. to accommodate a truck loaded with the plush. This opening was closed by a cast-iron door, 1 in. thick hinged at one edge; four bolts and lugs at the four corners were designed to hold the door against the steam pressure.

Purchased second-hand, the tank was installed in the factory on Sunday, Oct. 10. A 2-in. steam line connected it to the boiler house about 200 ft. distant, with a globe valve close to the tank. A pop safety valve set at 100 lb. was connected to a 1½-in. line at the top of the front head.

This work was performed by the mill hands and when completed, they turned on the steam in order to test the tightness of the joints. The pressure soon built up equal to that in the boilers and the cast-iron door ruptured vertically. The outrush of steam resulted in the death of two and the probable fatal burning of another.

Being an unfired vessel, no city permit was needed nor was an inspection by the city's boiler inspectors required.

New Station Starts Up For Gulf States Utilities

Gulf States Utilities Co., one of the Engineers Public Service Co. group, has announced the completion by Stone & Webster, Inc., of the first section of a new power station on the Neches River at Beaumont, Tex., at total cost of $3,500,000.

This station, the ultimate capacity of which is to be 300,000 kw., will help supply the increasing demand for electrical power in southeastern Texas and southern Louisiana.

Dr. Alexander C. Humphreys Resigns Stevens Post

Dr. Alexander C. Humphreys, for nearly twenty-five years president of the Stevens Institute of Technology at Hoboken, N. J., president of the A.S.M.E., 1912, and during his professional career was identified with more than 50 gas and electric light companies, offered his resignation at a meeting of the Board of Trustees in the Metropolitan Club. Dr. Humphreys acceded to the request of the board that he continue in office until the completion of his twenty-fifth year, on June 5, 1927.

In his letter of resignation, Dr. Humphreys said that he had contemplated resigning for some time, and that as he had passed his seventy-fifth year he felt the time was opportune for him to do so. Anson W. Burchard, vice-chairman of the board of the General Electric Co. and chairman of the finance committee of the trustees, presided at the meeting and at its conclusion he said:

"We all recognize that President Humphreys after many years of successful administration has earned relief from the burden of executive responsibility. We are planning to lighten the load at once, but asked him to continue as president until the completion of his twenty-fifth year.

Will Accept Chair

"The board has taken steps to amend the by-laws of the institute in order to change the title of the presiding officer of the Board of Trustees from 'president' to 'chairman.' President Humphreys has been asked to become chairman and has agreed to do so when his resignation as President becomes effective. This is one of the few instances in which the same individual has been president of the board as well as of the Faculty.

"The board, in recognition of President Humphreys's devotion and unselfish service resulting in a virtual renouncement of a distinguished career as the leading gas expert of his profession, voted a retiring allowance to supplement the retirement allowance to which he will become entitled from the Carnegie Foundation."

Mr. Burchard added that no candidates for the presidency of the institute had yet been considered. The alumni, he said, would be asked to assist in finding "a worthy successor to Henry Morton and Dr. Humphreys, the two great educators who have made Stevens Tech an institution which has trained a long list of the outstanding engineers of this country."

After the meeting, the trustees attended a dinner given by Mr. Burchard as an impromptu testimonial to Dr. Humphreys.

St. Lawrence Applicants Give Out Plans—Hearing Held

In order to give the two applicants for the development of St. Lawrence River water power, the St. Lawrence Valley Power Corp., which has contracted to sell it to the Frontier Corp., and the American Super Power Corp., an opportunity to present a picture of the financial structure it is proposed to build to provide funds to complete the project, if a license be granted to either applicant, the hearing of the New York State Water Power Commission was adjourned Oct. 15 until Monday, Oct. 25.

The Frontier Corp. offered in evidence a map showing a complete system of interlocking transmission lines covering practically the entire state of New York, outside of New York City and Long Island, and stated that it had tentative agreements with the electrical corporations owning such interlocking systems to take and distribute the current when generated.

Edison To Use Current

Edward C. Randall, president of the American Super Power Corp., testified that his company proposed to build one transmission line to the borders of the city of New York and that the New York Edison Co., with five associate companies, would be the beneficiary of such current to the extent of their peak load of 600,000 hp.

Mr. Randall further stated that it was proposed if his company was granted a license, to build a second transmission line of 220,000 volt capacity to carry 300,000 hp. from the St. Lawrence into the counties of the southern tier, and that it would be possible to transmit such electricity and sell it in New York City and the southern tier counties at a favorable price in competition with steam plants.

Over the protest of Fay C. Hamilton, chief executive officer of Henry L. Doherty & Co., New York, who owns a third of the stock of American Super Power Corp., that Nov. 8 would be the earliest consistent date on which a picture of the financial structure could be properly presented, the date of the next meeting of the commission was fixed in executive session for Oct. 25.

Chicago Power Show Plans Many Model Exhibits

During the week of Feb. 14, 1927, Chicago will become the center of interest for the power industry of the Middle West.

At that time the Midwestern Engineering Power Exposition will open its doors with a large exhibit of power-plant equipment covering the entire main floor of the Coliseum Building. Many of the exhibits will have working units or models equipped to show in detail the operation or the process of the equipment presented, thereby making it easily understood and connecting the theoretical with the principles of operation.

Advance information from the exhibitors makes it evident that there will be quite a number of new and altogether novel items ready for inspection at the show. The Coliseum Building offers a remarkable place for display, as it is large enough to permit all exhibits being placed on the ground floor.

During the same week and in the same building the Midwest Power Conference will be held. This conference, indorsed, sponsored and conducted by the local sections of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, National Electric Light Association, American Institute of Mining Engineers, National Safety Council and the Western Society of Engineers, will be of unusual importance to every power man. The meetings last year in Chicago were attended particularly well and the program and quality of speakers highly praised.

The program for the coming conference is now being arranged and will be ready for publication in the near future.

New York Joins Great Lakes Action Against Chicago

Attorney General Ottinger began, Oct. 18, an action in the United States Supreme Court to restrain the sanitary district of Chicago and the State of Illinois from diverting water from the Great Lakes and the St. Lawrence waterway. This step follows a decision handed down by the Supreme Court permitting New York to join five other states in opposing the proposed diversion. As this diversion is closely linked with power development, the complaint, if successful, will greatly affect electrical generation at Niagara and the rapids of the St. Lawrence.

The complaint recites that the sanitary district of Chicago, under the authority of the State of Illinois, has reversed the flow of the Chicago River, which formerly emptied its waters into Lake Michigan, so that by means of the Des Plaines and Illinois Rivers it flows into the Mississippi. By this means large quantities of water, averaging from 8,000 to 10,000 cubic feet per second, according to the complaint, are permanently abstracted from the Great Lakes-St. Lawrence waterway.

Open Defiance of Law

Deputy Attorney General Randall J. Lebeouf, Jr., is in charge of the case for New York under the direction of the Attorney General.

"The action of Chicago," said Attorney General Ottinger, "presents a case of a municipality in open defiance of law wilfully violating the rights of the Great Lakes States. The commerce on our great inland oceans is in the neighborhood of 125,000,000 tons per year, exclusive of the Canadian coastwise trade. A report of engineers of the United States Army estimates that the loss by the diversion at Chicago is about $325,000 a year for each thousand cubic feet per second diverted.

Less Power at Chicago

"Chicago took the water purely to save itself, at the expense of the Great Lakes States, the cost of installing modern sanitary sewage disposal works. The first use of any waterway is for sanitary purposes, but it is the recognized rule of law that at the end of such use, the water must be returned to the watershed.

"The sanitary district of Chicago also claims that by means of this diversion power is generated. Aside from the illegality of an abstraction of water for such use, the same water, if permitted to flow in its natural course to the sea over the Falls of Niagara and down the rapids of the St. Lawrence, would produce many times the power that can be obtained in the vicinity of Chicago.

"In recent years, when the Great Lakes States witnessed the water lowered in their harbor, shipping interfered with and mud flats beginning to appear on the shores of their lakes, Chicago then tried to justify its steal by claiming that it was for the benefit of navigation between the Great Lakes and the Mississippi."

German Manufacturer Talks on Diesel Industry

Unit capacities of Diesel engines are steadily showing an extension both at minimum and maximum points, so Dr. Imanual Lauster declared upon arriving in this country Oct. 19.

Doctor Lauster, who is Director General of the M. A. N. Co., of Germany, was a co-worker with Doctor Diesel and it was largely his practical experience that made the high-compression oil engine a commercial machine.

He mentioned the 15,000-hp. Diesel recently installed at Hamburg and expressed the belief that eventually many hydro-electric and steam-generating stations would use large Diesels to carry peak loads. The former disparity between the cost of a steam and a Diesel plant is rapidly disappearing, and he predicted that within five years a Diesel station would cost 25 per cent less than a steam-turbine installation. As an example of the tendency to large units he cited the licenses of M. A. N. held in this country by the Hooven-Owen-Rentschler Co. and the New London Ship & Engine Co., both of which are building units of over 3,000 hp.

It is in the adaptation of the Diesel to trucks and automobiles that Doctor Lauster displayed most interest. His company is building such engines weighing 12 lb. per horsepower and has granted a license for this design to the Buda Co., of Harvey, Ill.

The M. A. N. light-weight engine is of the solid-injection type, and Doctor Lauster expressed the belief that in the future the injection-air compression would completely disappear. At present the M. A. N. Co. has an experimental single-cylinder, solid-injection engine of 1,000-hp. capacity which is operating successfully.

In answer to an inquiry as to the Pawlikowski powdered-coal engine at Gorfitz, Germany, he stated that the engine was aparently operating quite satisfactorily, but expressed a doubt as to its ultimate commercial success. At present a special low-ash coal must be used, and if low-temperature distillation of coal is a success, the cost of tar oil will be so low as to make the burning of the raw coal unprofitable.

Japan To Hold Engineering Conference in 1929

Aspirations for the holding of an international conference in Japan were put in the way of realization when Dr. M. Kamo, president of the Society of Mechanical Engineers, the leading engineering body in Japan, and head of the department of mechanical engineering at the University of Tokio, announced at a luncheon tendered him at the Engineers' Club, New York City, Oct. 20, that the engineers of Japan were enthusiastically planning such a meeting. He read a cablegram, just received, to the effect that the government has granted a subsidy for the purpose, and he said that the various American engineering societies would receive formal invitations in the early future. The date of the gathering is fixed tentatively for October, 1929.

Doctor Kamo is passing through this country on his return from the World Power Conference at Basel. He also represented Japan at the World Power Conference at London in 1924.

After consultation with the engineering authorities of his country Doctor Kamo reported that the suggestion had been received with enthusiasm, and on his return to America advance was made.

On reaching Japan the interest of the government was solicited. In the interim the matter was taken up in a similar manner in the United States through discussions among the officers of the five engineering societies, namely; the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, and the Society of Naval Architects and Marine Engineers and with no other than our engineer member of the President's cabinet in Washingon, Hon. Herbert Hoover, Secretary of Commerce, from whose response the following is a quotation:

"I am entirely sympathetic with the idea of a World's Congress of Engineers in Japan. I think it would be a well deserved compliment to the progress made in Japan for the engineers of the world to send representation to such a conference."

Fifty-millionth Horsepower Reached in United States

With the arrival at the 50-millionth horsepower mark reached in the productive capacity of the United States Sept. 1 of this year, there has been realized a prime mechanical force of 450 hp. for each thousand of population in this country, according to a report issued recently by the National Electric Light Association.

Regardless of wars, depressions or "business cycles," prime-mover machinery in industries and the power houses of the country has increased with phenomenal regularity since the beginning of the present century. While the grand total of power is growing at an even rate, the installation of prime movers in factories has reached its peak and is now showing a decline. Industries have, in some cases, found it more profitable to secure their power from the lines of the light and power companies rather than to make it themselves.

The 450 hp. per thousand of our population, it is pointed out, compares with 310 hp. for Great Britain and "immediately suggests one reason for the present disparity in the prosperity of the two countries."

Steam Specialty Men Meet for Annual Convention

The National Steam Specialty Manufacturers Association held their annual meeting at Mt. Clemens, Mich., from Oct. 14-16.

Verner F. Davis, president of the Atlas Valve Co., James McAleer, vice-president of the McAleer Manufacturing Co., and Charles B. Klingermann, secretary of the Ruggles Klingermann Manufacturing Co., were unanimously re-elected for another term.

The annual golf tournament of the association was played at the same time, A. Fitzgerald, of the Morehead Manufacturing Co., winning the cup, which during the past year was held by Frank Morrison, of the Mason Regulator Co.

New Plant To Supply Power for Eastern Shore, Md.

In a recent statement made at Salisbury, Md., by F. N. Layton, general manager of the Eastern Shore Gas & Electric Co., assurance was given that the proposed new $1,500,000 power plant to be erected by his company will be sufficiently large to supply power in pratically any quantity to all points on the Delmarvia Peninsula, Md., furnishing all points south of Wilmington with practically no limit on the power supply fixed.

Decision as to the location of the new power plant has not yet been made, but with final selection of a site work on construction will begin without delay.

New Insulating Material Is Made by German Firm

A German company located in Schierstein on the Rhine is manufacturing a new insulating material known under the trade name of "Peralit," according to a report to the Department of Commerce from Trade Commissioner Theodore Pilger, Berlin.

This new product is intended to replace fiber, hard rubber and other insulating materials. It is built up of layers of certain materials, the nature of which is not reported, and subjected to very high pressure with application of heat. The insulating material has a high electrical resistance and is said to keep its shape up to 200 deg. C.

Mutual Power Plan Favored for Idaho Development

Formation of the People's Mutual Power Co., a corporation organized with an authorized capital stock of a million dollars, was completed at Twin Falls, Idaho, Oct. 13, when members of several grange organizations of that section signed articles of incorporation and stock subscription lists.

The purpose of the company is to develop the Clear Lake Power site on the Snake River, north of Buhl, in accordance with plans outlined by Barry Dibble, electrical engineer, who several weeks ago submitted a proposal to the Twin Falls city council for consideration.

East's Hydro Projects Twice Capacity of Western

Of the 3,866,000 hp. which have been placed under license since the enactment of the Water Power Act in 1920, nearly 40 per cent was put under construction during the last fiscal year.

The projects licensed during the last fiscal year and their ultimate installations are as follows: Susquehanna Power Co. and Philadelphia Electric Power Co., Susquehanna River, 473,000 hp.; Alabama Power Co., Lock 18, Coosa River, 180,000 hp.; Nevada Irrigation District, Yuba River, 150,000 hp.; Louisville Hydro-Electric Co., Ohio River, 135,000 hp.; Mt. Shasta Power Co., Pitt River, No. 4, 100,000 hp.; San Joaquin Light & Power Co., Kings River, 65,000 hp.; Feather River Power Co., Feather River, 60,000 hp.; Pacific Gas & Electric Co., Mokelumne River, 42,000 hp.; various small projects 15,000 hp.

Obituary

Richard Edwards Breed, widely known public utilities director, died Oct. 14 in Roosevelt Hospital, New York City, from toxic infection, the Associated Press reports. He underwent an operation two weeks ago.

Mr. Breed, a grandson of the late Richard Edwards Breed, of Pittsburgh, was born in Pittsburgh March 17, 1866. He came to New York twenty years ago. He was a director of the American Light & Power Co., the Electric Light & Power Corp., the Carolina Power & Light Co., the Wheeling Bank & Trust Co. and several other corporations.

Personal Mention

Miles Cary is now located with the Virginia Electric & Power Co. as mechanical engineer of the Norfolk division.

J. F. Downie Smith, assistant professor of Experimental Engineering at Atlanta, Ga., is connected with the Department of Graphics, of the Virginia Polytechnic Institute, Blacksburg, Va.

Walter N. Flanagan, for eight years steam engineer in the Youngstown district for the Carnegie Steel Co., has been added to the staff of the chief mechanical engineer of the company in Pittsburgh.

O. L. McIntyre, for the past six years construction engineer for the Fuller-Lehigh Co., Fullerton, Pa., has resigned and will be located in Berkeley, Calif.

Alexander L. Byfield has changed his position as a sales engineer of the George B. Limbert & Co., of Chicago, to that of power engineer of the Cowham Engineering Co., (Consolidated Cement Corporations) Chicago, Ill.

G. L. Tuve, formerly connected with the Experimental Engineering Laboratories, University of Minnesota, Minneapolis, Minn., is now associate professor of mechanical engineering at the Texas Technological College, Lubbock.

Dr. Imanuel Lauster, director general of the M. A. N. Co., of Germany, arrived in New York City on Oct. 18. He will visit the several firms holding licenses to build M. A. N. Diesels, He expects also to devote at least two weeks of his time in visiting American Manufacturers.

H. N. Covell who recently retired with honors as secretary of the American Boiler Manufacturers' Association has not been allowed to remain in retirement. His many friends will be glad to learn that he has accepted a position as works manager of the Virginia Alberene Corp., miners and fabricators of soapstone at Schuyler, Va., where it owns the largest deposit of soapstone in the world and employs between 800 and 1,000 men.

Society Affairs

The Franklin Institute at Philadelphia will be addressed on Nov. 4 by William F. Paris, consulting lubrication engineer of New York City, on the subject of the "Distillation of Petroleum for the Manufacture of Lubricating Oils."

Business Notes

The Link-Belt Co.'s Boston office, formerly located at 49 Federal St., will move Nov. 1 to its new headquarters at 1103-1104 Statler Bldg.

The Pennsylvania Pump and Compressor Co. has appointed Lee & Clark, 549 Washington Blvd., Chicago, Ill., representatives in the Chicago district.

The Hardinge Co., York, Pa., reports that after Nov. 1 the Salt Lake City office will be located in the Continental Bank Bldg., 200 South Main St., Salt Lake City, Utah. W. L. Penick will be in charge.

American Hammered Piston Ring Co. announces that George Boehner has joined the sales organization, and will have as his territory Minnesota and North and South Dakota. Mr. Boehner's headquarters will be at Minneapolis.

The Bridgeport Brass Co. has acquired for the Cleveland office, 2017 Superior Viaduct, the services of J. R. Brandt as raw material salesman in the Pittsburgh territory and parts of Ohio. Formerly, Mr. Brandt was associated with the U. S. Copper Products Corp., Rome Hollow Wire & Tube Co., and the Hennig Nickel Rolling Mills.

The F. Beers & Co., Federal Trust Bldg., Newark, N. J., in the specialty of all branches of oil burning and boiler baffling, and representing the Boiler Engineering Co., builders of BECO, announce that E. S. Hammond, who has been trouble man and salesman for the W. N. Best Corp. for the last thirteen years, is now associated with F. Beers & Co.

Coming Conventions

American Engineering Council. Annual meeting at Washington, D. C., Jan. 13-15. L. W. Wallace, 24 Jackson Place, Washington, D. C.

American Welding Society. Annual Fall Meeting, at Buffalo, N. Y., Nov. 16-19. Gideon W. Swan, general chairman, Morgan Bldg., Buffalo, First International Welding Exposition will be held in conjunction with meeting.

Engineering Institute of Canada. Annual meeting Jan. 18. Richard John Durley, secretary, 176 Mansfield St., Montreal, Que.

Chicago Power Show, at Chicago, Feb. 15-19. G. E. Pfisterer, managing director, 53 West Jackson Blvd., Chicago.

National Association of Practical Refrigerating Engineers. Annual Convention and Exhibition at Kansas City, Mo., Nov. 2-5. Edward H. Fox, secretary, 5707 W. Lake St., Chicago, Ill.

National Electric Light Association. A. Jackson Marshall, secretary, 29 West 39th St., New York City. Annual convention at Atlantic City, week beginning June 6.

National Exposition of Power and Mechanical Engineering, Fifth Annual Exposition at Grand Central Palace, New York City, Dec. 6-11.

National Marine Engineers' Beneficial Association. Fifty-third annual convention at Washington, D. C., Feb. 14. Albert L. Jones, secretary-treasurer.

Society of Naval Architects and Marine Engineers. Thirty-fourth annual meeting at Engineering Societies Bldg., 29 West 39th St., New York City, Nov. 11 and 12. T. J. Kain, assistant secretary-treasurer.

Trade Catalogs

Lubrication and Filtration—Wm. W. Nugent & Co., Chicago, Ill., manufacturers of oiling devices. This is a miniature bulletin and description of the principal products of the company, compiled especially for general distribution.

Ball Bearing Gearless Crusher—The Kennedy-Van Saun Manufacturing and Engineering Corp., of New York City, has issued a folder on the gyratory crushers for primary and secondary operations, with a capacity of 15 tons to 2,500 tons per hour.

Steam Specialties, Valves, Traps, etc.—The Strong, Carlisle & Hammond Co., of Cleveland, has just issued Catalog No. 30 on the company's latest steam specialties, covering heavy duty valves, steam traps, pump governors, separators, vacuum traps, reducing valves, engines stops, and non-return stop valves.

Ball Bearings for Electric Motors—The Fafnir Bearing Co. has printed new booklet which will be of interest, putting before the user, rather than the manufacturer, of electric motors, the story of the savings and economies which ball bearing motors will give him in his plant. The book is full of facts, figures and quotations from experiences in plants. The book is of especial interest to superintendents, maintenance men and electrical engineers.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	Oct. 18 1926
Pool 1	New York	$2.75@$3.00
Smokeless	Boston	3.55
Clearfield	Boston	2.25@ 2.85
Somerset	Boston	2.15@ 2.25
Kanawha	Columbus	2.00@ 2.50
Hocking	Columbus	1.60@ 2.00
Pittsburgh	Pittsburgh	2.15@ 2.30
Pittsburgh gas slack	Pittsburgh	1.70@ 1.80
Franklin, Ill.	Chicago	2.35@ 2.50
Central, Ill.	Chicago	2.15@ 2.25
Ind. 4th Vein	Chicago	2.15@ 2.35
West Ky.	Louisville	1.15@ 1.50
S. E. Ky.	Louisville	1.75@ 2.25
Big Seam	Birmingham	1.75@ 2.00
Anthracite Gross Tons		
Buckwheat No. 1	New York	2.15@ 3.50
Buckwheat No. 1	Philadelphia	2.25@ 3.00
Birdseye	New York	1.40@ 2.00

FUEL OIL

New York—Oct. 21, light oil, tank-car lots; 28@34 deg. Baumé, 6c. per gal.; 36@40 deg., 6¾c. per gal. f.o.b. Bayonne, N. J.

St. Louis—Oct. 13, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2.10 per bbl.; 26@28 deg., $2.15 per bbl.; 28@30 deg., $2.20 per bbl.; 30@32 deg., $2.25 per bbl.; 32@36 deg., gas oil, 6c. per gal.; 38@40 deg., 7¾c. per gal.

Pittsburgh—Oct. 12, f.o.b. local refinery; 30@34 deg., fuel oil, 6c. per gal.; 36@40 deg., fuel oil, 6½c. per gal.

Dallas—Sept. 22, f.o.b. local refinery 26@30 deg., $1.70 per bbl.

Philadelphia—Oct. 17, 27@30 deg., $2.52@$2.58 per bbl.; 13@19 deg., $1.59 @$1.65 per bbl.

Cincinnati—Oct. 19, tank-car lots f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6⅝c. per gal.; 30@32 deg., 7c. per gal.

Chicago—Oct. 18, tank-car lots f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.35@$1.40 per bbl.; 26@30 deg., $1.50@$1.55; 30@32 deg., $1.75.

Boston—Oct. 18, tank-car lots f.o.b. 12@14 deg. Baumé, 4.8c. per gal.; 28@32 deg., 6c. per gal.

New Plant Construction

Ala., Birmingham—E. I. du Pont De Nemours & Co., Wilmington, Del., has completed plans for the construction of a plant to consist of approximately 50 separate buildings including power units, etc. here. H. S. Stanton of the Du Pont Engineering Co., the builders, is construction superintendent.

Ark., Helena—City is having preliminary plans prepared for the construction of a sewage disposal plant, pumping stations, etc. for Sewer Improvement Dist. 2. Estimated cost $100,000. L. R. Parmalee, City Hall, is engineer.

Calif., Alameda—Bd. of Public Utilities, A. D. Goldsworthy, Secy., plans to purchase two 500 kva. transformers.

Calif., Los Angeles—Title Insurance & Trust Co., Title Insurance Bldg., awarded contract for the construction of a 12 story office and stores building on Spring St., to Scofield Engineering Construction Co., Pacific Finance Bldg. Estimated cost $1,500,000.

Calif., Mare Island—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans the installation of four 300 hp. water tube boilers, oil burning equipment, etc. at Navy Yard hospital here.

Calif., San Diego—R. T. Robinson, First National Bank Bldg., awarded contract for the construction of a 12 story apartment on San Diego St., to Wm. Simpson Construction Co., Bank of Italy Bldg., Los Angeles. Estimated cost $800,000. Steam heating system, etc., will be installed.

Ill., Chicago—Dept. of Public Works, A. A. Sprague, Comr., will receive bids until Oct. 29 for furnishing and installing 2 motor-driven centrifugal oil purifiers at 49th St. and Western Ave. pumping station.

Ill., Chicago—Estate of Marshall Field, 25 East Washington St., awarded contract for masonry, etc. for a 24 story office and stores building at Wabash Ave. and Washington St. to Henry Ericsson Co., 111 West Washington St. Estimated cost $5,000,000.

Ill., Chicago—Rosenthal, Mayer & Lewis, 77 West Washington St., is having plans prepared for the construction of a 15 story apartment at Surf St. and Commonwealth Ave. Estimated cost $2,000,000. Olsen & Urbain, 134 North La Salle St., are architects.

Ill., Chicago—St. Ann's Hospital, Poor Hand Maids of Jesus Christ, 4900 Thames St., awarded contract for masonry, etc. for a 6 story hospital at Lavergne and Lamon Aves., West Division and Thomas Sts., to C. J. Rose & Son, 1814 Mohawk St. Estimated cost $1,000,000.

Ill., Chicago—Stratford Place Bldg. Corp., 1509 Howard St., awarded contract for masonry, etc. for a 12 story apartment at 529 Cornelia Ave. to Hallbauer-LaBahn Inc., 844 Rush St. Estimated cost $750,000.

Ill., Oak Park—Eight Hundred Thirty Nine Lake Street Building Corp., awarded contract for the construction of a 5 story hotel to Tidewater Construction Co., 11 South La Salle St. Estimated cost $500,000.

Ind., Terre Haute—C. F. Heirs, had plans prepared for the construction of a hotel. Estimated cost $1,000,000. W. A. Russ, 313 North Penn. St., Indianapolis, is architect.

Ky., Louisville—Louisville Water Co., 435 South 3rd St. J. Chambers, Ch. Engr. will receive bids until Nov. 2 for improvements to waterworks including pumping station and filter plant, two 500 hp. water tube boilers, 1,000,000 gal. reservoir, etc. Alvord, Burdick & Howson, 8 South Dearborn St., Chicago, Ill., are engineers.

La., Cedar Grove—Independent Ice & Refrigerator Co., Abilene, Tex., is having preliminary plans prepared for the construction of a 40 ton ice plant here. Estimated cost $50,000. Private plans.

La., Shreveport—Local Syndicate, c/o Benson Realty Co., 502 Atkins St., will receive bids about Dec. 4, for the construction of a 12 story office building at Travis and Louisiana Sts. Estimated cost $1,000,000. Long & Witchell, American Bank Bldg., Dallas, Tex., are architects.

Mass., Boston—Supply Dept., H. S. Frost, Supt., will receive bids until Oct. 28, for electric refrigeration equipment for Boston City Hospital on Harrison Ave.

Mass., Holyoke—Germania Mills, Race St., is receiving bids for the construction of addition to boiler house. Estimated cost $40,000. McClintock & Craig, 458 Bridge St., Springfield, are engineers.

Mass., Lynn—Commission of Ways & Drainage, had revised plans prepared for the construction of a sewage pumping station. Morris Knowles Inc., 507 Westinghouse Bldg., Pittsburgh, Pa., is engineer. Former bids rejected.

Mich., Detroit—Detroit Community Fund, 316 East Jefferson Ave., awarded contract for the construction of a 4 story office building on Warren Ave. to Martin & Krausman Co., 955 East Jefferson Ave. Estimated cost $800,000. Steam heating equipment will be installed.

Mich., Detroit—William Fox, c/o C. H. Crane, 543 Griswold St., Archt., will soon award contract for the construction of a 19 story theatre and office building including steam heating equipment, elevators, etc. on Woodward Ave.

Minn., Minneapolis—First Unitarian Church, 8th St. and La Salle Ave., is having plans prepared for the construction of an 8 story church and office building including steam heating system, etc. Estimated cost $750,000. Long & Thorshov, 1028 Andrus Bldg., are architects.

Minn., North Mankato (Mankato P. O.)—City plans an election Nov. 2 to vote $20,000 bonds for the installation of two wells and pumps.

Mo., Jefferson City—Central Hotel Co., awarded contract for the construction of a 10 story hotel to G. F. Green, Rialto Bldg., Kansas City.

N. H., Concord—St. Paul's School, J. Walker, Bus. Mgr., awarded contract for the construction of a power plant on Dunbarton Rd. to L. H. Shattuck Inc., 208 Granite St., Manchester.

N. J., Ocean City—Atlantic Hotel Co., T. W. White, Overbrook, Pa., plans the construction of a 4 story hotel here. Estimated cost $1,250,000. A. B. Lacey, 1012 Walnut St., Philadelphia, Pa., is architect.

N. Y., Brooklyn—Dept. of Public Welfare, Municipal Bldg., will soon award contract for the construction of addition to power house and boiler plant at Kings County Hospital.

N. Y., Brooklyn—J. F. I. Construction Co. Inc., c/o A. J. Simberg, 1133 Broadway, Archt., is having plans prepared for the construction of a 12 story apartment at Greene and Clinton Aves. Estimated cost $750,000.

N. Y., Brooklyn—State Hospital Comn., Capitol, Albany, will receive bids until Nov. 10, for heating work, new boiler and piping, etc. at Brooklyn State Hospital, here.

N. Y., Middletown—State Hospital Comn., Capitol, Albany, will receive bids about Dec., for the installation of a refrigeration plant in Middletown State Hospital, here.

N. Y., New York—Adams Flanigan, Westchester and 3rd Aves., will receive bids about Nov. 1 for the construction of a 6 story department store including electric elevators, etc. at 149th St. and 3rd Ave. Estimated cost $800,000. Starrett & Van Vleck, 393 7th Ave., are architects.

N. Y., New York—L. Goldner, c/o Sommerfeld & Sass, 31 Union Sq., Archts., will build two 12 apartments including 4 electric elevators, etc. on Bennett Ave. Estimated cost $1,000,000. Work will be done by separate contracts under the owner's supervision.

N. Y., New York—Preferred Bldg. Corp., L. Minoff, Pres., 65 East 175th St., will build a 15 story apartment including 4 electric elevators, etc. on Grand Concourse. Estimated cost $3,000,000. S. Schaeffer, Jr., 148th St. and 3rd Ave., is architect. Work will be done by separate contracts under the owner's supervision.

N. Y., New York—Twenty Eight East 52nd St. Corp., A. Brisbane, Pres., 238 William St., will soon receive bids for the construction of a 28 story office building on Madison Ave. Estimated cost $1,650,000. Rouse & Goldstone, 512 5th Ave., are architects and engineers.

N. C., Kernersville—S. F. Vance, Mayor and Board of Comrs., will receive bids until Nov. 23, for waterworks improvements including 1,000,000 gal. water purification plant, dam, pumping station, reservoir, etc. The Carolina Engineering Co., 917 Johnson Bldg., Charlotte, is engineer. G. H. Bishop is consulting engineer.

O., Cleveland—American Steel & Wire Co., Rockefeller Bldg., awarded contract for the construction of addition to power house and gas blowing engine house at River Rd. and Broadway. Estimated cost $75,000.

O., Cleveland—The Graphic Arts Bldg. Co., c/o W. J. Austin of the Austin Co., 16112 Euclid Ave., is having plans prepared for the construction of a 6 story graphic arts building including steam heating system, elevators, etc. on East 21st St. Estimated cost $500,000. Private plans.

O., Cleveland—Victory Auto Trimming & Painting Co., M. C. Fodor, Pres., is having plans prepared for the construction of addition to boiler house on St. Clair Ave. Estimated cost $40,000.

O., Lancaster—Dept. of Welfare, J. E. Harper, Oak and Ninth Sts., Columbus, will soon award contract for the construction of a power house, etc. at Boys' Industrial School here.

Okla., Carmen—J. H. Putman, plans the construction of a 40 ton ice plant. Estimated cost $60,000. Private plans.

Okla., Ringling—City had preliminary plans prepared for improvements to waterworks including new wells, 2 motor driven centrifugal pumps, 2 motor driven air compressors, etc. Estimated cost $20,000. Engineer not announced.

Tex., Amarillo—City, J. D. Bartlett, Mgr., will receive bids until Nov. 8, for furnishing and installing one 4,000,000 g.p.d. and one 6,000,000 g.p.d. sychronous motor driven centrifugal pumping engines, switchboard, etc. H. B. Jones is engineer.

Tex., Boerne—City voted $60,000 bonds for waterworks improvements including pumping equipment, mains, etc. H. L. Davis, mayor.

Tex., San Antonio—City plans an election Nov. 15 to vote $75,000 bonds for the installation of a refrigeration plant in new auditorium. I. Ewig, is city engineer.

Wash., Seattle—Arcade Building & Realty Co., Arcade Bldg., plans the construction of an 8 story stores building at 2nd and Union Sts. Estimated cost $1,500,000. H. & C. Thomas, Arcade Bldg., are architects. Rhodes Bros. Co., Department Store, 1321 2nd St., is lessee.

Wis., Ashland—Lake Superior District Power Co., 212 2nd St., W., awarded contract for improvements to dam to L. E. Myers Co., 53 West Jackson Blvd., Chicago, Ill. Estimated cost $50,000.

B. C., New Westminster—City plans the construction of a cold storage plant. Estimated cost $4,000,000. A. Annandale, mayor.

Ont., London—London Hotel Co., J. J. McHale, Pres., awarded contract for the construction of a 10 story hotel on Dundas St to John V. Gray Construction Co., Bartlett Bldg., Windsor. Estimated cost $1,250,000. Steam heating system will be installed.

Que., Montreal—Canadian Carbonate Ltd., 1 Hadley St., is in the market for a 40 hp. electric motor.

N. Z., Wellington—Dept. of Public Works, Supplies and Tenders Board, is in the market for storage battery and booster 120 cells complete with spares and accessories; 1 motor booster and switchboard erected complete.

Mexico, Centepec—Mexican Light & Power Co., Gantee St., Mexico City, has been granted concession by the Mexican Government to construct a hydro electric plant and dam on the Lerma River near here in the state of Michoacan. The dam will impound 500,000,000 cu. meters of water which will be used in irrigating more than 600,000 hectares of agricultural land, also to furnish power for proposed power plant. Estimated cost approximately $18,000,000. Private plans.